



ANNALS  
OF  
SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

EDITED BY  
LEWIS STEPHEN PILCHER, M D, LL D,  
OF NEW YORK

WITH THE ASSOCIATION OF  
JAMES TAFT PILCHER, B A, M D,  
AND THE COLLABORATION OF  
W SAMPSON HANDLEY, M S, M D, F R C S,  
OF LONDON

---

VOLUME LXXXII  
JULY—DECEMBER, 1925

---

PHILADELPHIA  
J B LIPPINCOTT COMPANY  
1925



COPYRIGHT BY  
J B LIPPINCOTT COMPANY  
1925

# CONTRIBUTORS TO VOLUME LXXXII

ADIE, GEORGE C, Ann Arbor, Mich  
 BALFOUR, DONALD C, Rochester, Minn  
 BIER, EDWIN, New York, N Y  
 BLRESNEGOVSKI, N J, Siberia  
 BERKMAN, DAVID M, Rochester, Minn  
 BEST, R RUSSELL, Omaha, Neb  
 BLAKE, JOSEPH A, New York, N Y  
 BRUNKOW, CLARENCE W, Minneapolis, Minn  
 BUCHANAN, J J, Pittsburgh, Pa  
 BUIL, LOUIS A, Rochester, Minn  
 BUNTS, FRANK E, Cleveland, Ohio  
 BURDEN, VERNER G, Rochester, Minn  
 CABOT, HUGH, Ann Arbor, Mich  
 CARREL, ALEXIS, New York, N Y  
 CARSON, WILLIAM JAMES, Baltimore, Md  
 CARTER, R FRANKLIN, New York, N Y  
 CAYLOR, HAROLD D, Rochester, Minn  
 CHEATL, SIR GEORGE LENTHAL, London, England  
 CLOPTON, MAVERN B, St Louis, Mo  
 COHEN, IRA, New York, N Y  
 COLE, WARREN H, St Louis, Mo  
 COLLY, WILLIAM B, New York, N Y  
 CONNORS, JOHN F, New York, N Y  
 COLP, RALPH, New York, N Y  
 CONWELL, H EARLE, Fairfield, Ala  
 CRAVER, LLOYD F, New York, N Y  
 CRUI, GEORGE W, Cleveland, Ohio  
 CULVER, HARRY B, Chicago, Ill  
 DANDY, WALTER E, Baltimore, Md  
 DAVID, VERNON C, Chicago, Ill  
 DAVIS, JOHN STAIGL, Baltimore, Md  
 DAVIS, LINCOLN, Boston, Mass  
 DEANER, JOHN B, Philadelphia, Pa  
 DECOURCY, JOSEPH L, Cincinnati, Ohio  
 DODSON, A I, Richmond, Va  
 DORRANCE, GEORGE M, Philadelphia, Pa  
 DUFFY, GIFFORD S, New York, N Y  
 DUNN, LOUIS, Minneapolis, Minn  
 DWIGHT, KIRBY, New York, N Y  
 EISENBATH, DANIEL N, Chicago, Ill  
 ELIASON, E L, Philadelphia, Pa

## CONTRIBUTORS TO VOLUME LXXXII

ELIOT, ELLSWORTH, JR, New York, N Y  
 ELSBERG, CHARLES A, New York, N Y  
 ELTING, ARTHUR W, Albany, N Y  
 ERDMAN, SEWARD, New York, N Y  
 ESTES, WILLIAM L, Bethlehem, Pa  
 EUSTERMAN, GEORGE B, Rochester, Minn  
 FARR, CHARLES E, New York, N Y  
 FARR, ROBERT EMMETT, Minneapolis, Minn  
 FELDMAN, ROBERT H, New York, N Y  
 FISCHER, HLRMANN, New York, N Y  
 FOWLER, W FRANK, Rochester, N Y  
 FRAWLEY, JOHN M, Rochester, Minn  
 FRAZIER, CHARLES H, Philadelphia, Pa  
 GATCH, WILLIS D, Indianapolis, Ind  
 GRAHAM, ALLEN, Cleveland, Ohio  
 GERSTER, JOHN C A, New York, N Y  
 GIBBON, JOHN H, Philadelphia, Pa  
 GIBSON, THOMAS E, San Francisco, Cal  
 GREEN, NATHAN W, New York, N Y  
 GREEN, W T, Indianapolis, Ind  
 GRUCA, ADAM, Lwow, Poland  
 HANSELL, H S, United States Army  
 HARTMAN, HOWARD R, Rochester, Minn  
 HARTWELL, JOHN A, New York, N Y  
 HERENDEEN, RALPH E, New York, N Y  
 HEYD, CHARLES GORDON, New York, N Y  
 HIGGINS, C C, Cleveland, Ohio  
 HINMAN, FRANK, San Francisco, Cal  
 HITZROT, JAMES M, New York, N Y  
 HOLDER, HALL G, San Diego, Cal  
 HOMANS, JOHN, Boston, Mass  
 HORSLEY, J SHELTON, Richmond, Va  
 IVY, ROBERT H, Philadelphia, Pa  
 JACKSON, CHEVALIER, Philadelphia, Pa  
 JONES, DANIEL F, Boston, Mass  
 JOPSON, JOHN H, Philadelphia, Pa  
 JUDD, EDWARD STARR, Rochester, Minn  
 KERR, HARRY HYLAND, Washington, D C  
 KLINGENSTEIN, PERCY, New York, N Y  
 KOSTER, HARRY, Brooklyn, N Y  
 KUTZMANN, ADOLPH A, Los Angeles, Cal  
 LASERSOHN, MARTIN, Richmond, Va  
 LEE, BURTON J, New York, N Y  
 LEE, WALTER ESTELL, Philadelphia, Pa  
 LEWIN, PHILIP, Chicago, Ill

## CONTRIBUTORS TO VOLUME LXXXII

LEWISOHN, RICHARD, New York, N Y  
 LILIENTHAL, HOWARD, New York, N Y  
 LOWER, WILLIAM E, Cleveland, Ohio  
 LUSK, WILLIAM C, New York, N Y  
 LUTZ, HARRY, Augusta, Kans  
 LYLE, HENRY H M, New York, N Y  
 MACEWEN, JOHN A C, Glasgow, Scotland  
 MALONEY, JOHN J, Cincinnati, Ohio  
 MARTIN, CHARLES E, Albany, N Y  
 MARTIN, WALTON, New York, N Y  
 MATHEWS, FRANK S, New York, N Y  
 MAYO, CHARLES H, Rochester, Minn  
 MCCREERY, JOHN A, New York, N Y  
 MCWILLIAMS, CLARENCE, New York, N Y  
 MELENEY, FRANK, Peking, China  
 MENNINGER, WILLIAM C, Topeka, Kans  
 MEYER, WILLY, New York, N Y  
 MILLER, CHARLES CONRAD, Chicago, Ill  
 MILLIKEN, SETH M, New York, N Y  
 MIXTER, WILLIAM JASON, Boston, Mass  
 MONTGOMERY, JAMES G, Kansas City, Mo  
 MORRIS, ROBERT T, New York, N Y  
 MOSCHCOWITZ, ALEXIS V, New York, N Y  
 NOBLE, THOMAS P, Rochester, Minn  
 OCHSNER, ALBERT J, Chicago, Ill  
 O'CONOR, JOHN, Buenos Aires, Argentina  
 PICK, CHARLES H, New York, N Y  
 PERSSON, MAURITZ, Stockholm, Sweden  
 PETERSON, EDWARD W, New York, N Y  
 PREIFFER, DAMON B, Philadelphia, Pa  
 PHIFER, FRANK M, Chicago, Ill  
 POOL, EUGENE H, New York, N Y  
 PRIMROSE, ALEXANDER, Toronto, Ontario  
 PRIOR, JESSIE W, Philadelphia, Pa  
 PUTFORD, D SCHUYLER, JR, Rochester, Minn  
 REIMANN, STANLEY PHILIP, Philadelphia, Pa  
 ROEDMAN, JOHN S, Philadelphia, Pa  
 ROTHSCHILD, NORMAN S, Philadelphia, Pa  
 RUSSELL, JAMES I, New York, N Y  
 SARNOFF, JACOB, Brooklyn, N Y  
 SHARPE, WILLIAM, New York, N Y  
 SHIPLEY, ARTHUR M, Baltimore, Md  
 SMYTHE, CALVIN, Philadelphia, Pa  
 SPID, KELLOGG, Chicago, Ill  
 STEPHEN DE WITT, New York, N Y

## CONTRIBUTORS TO VOLUME LXXXII

STEVENS, G W , Milwaukee, Wis  
 STRICKER, P , Strasbourg, France  
 STULZ, E , Strasbourg, France  
 SUTTON, H B , Ithaca, N Y  
 SUTTON, JOHN E , JR , New York, N Y  
 SWAN, THEODORE S , Rochester, Minn  
 THOMASON, THOMAS HERBERT, Fort Worth, Texas  
 TINKER, MARTIN B , Ithaca, N Y  
 TOREK, FRANZ, New York, N Y  
 TRAUT, HERBERT F , Baltimore, Md  
 TRUESDELL, EDWARD D , New York, N Y  
 VAN BEUREN, F T JR , New York, N Y  
 VIETOR, JOHN A , New York, N Y  
 VINSON, PORTER P , Rochester, Minn  
 WALTHER, HENRY W E , New Orleans, La  
 WATSON, LEIGH F , Chicago, Ill  
 WELLS, J RALSTON, Philadelphia, Pa  
 WIENER, JOSEPH, New York, N Y  
 WILENSKY, ABRAHAM O , New York, N Y  
 WILLIS, A MURAT, Richmond, Va  
 WILLIS, BYRD CHARLES, Rocky Mount, N C  
 WHIPPLE, ALLEN O , New York, N Y  
 WHITMAN, ROYAL, New York, N Y  
 WOHL, MICHAEL G , Omaha, Neb  
 WOOLSEY, GFORGE, New York, N Y  
 YATES, JOHN LAWRENCE, Milwaukee, Wis

# ANNALS *of* SURGERY

VOL LXXXII

JULY, 1925

No 1

## MECHANISM OF THE FORMATION AND GROWTH OF MALIGNANT TUMORS

BY ALEXIS CARREL, M D

OF NEW YORK, N Y

FROM THE LABORATORIES OF THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

WE CAN hardly expect to cure malignant tumors, or to prevent their occurrence, as long as the factors determining their formation and the conditions of their growth remain unknown. The problem of cancer must be attacked from its physiological side. We have to discover by what process a group of cells acquires the power to proliferate indefinitely among the dormant tissues of the adult animal. The growth of cancer is certainly determined by conditions as precise as those ruling the development of normal tissues. It is true that malignant cells do not obey the common law. But their anarchical appearance must be attributed merely to our lack of knowledge of the properties causing their peculiar behavior. If we knew all the factors capable of producing cell proliferation and dedifferentiation, we could understand the genesis of cancer. Conversely, the discovery of the nature of malignant tumors would certainly advance our knowledge of the mechanisms of tissue growth. Instead of merely searching for the virus, bacteria, helminths, or chemical substances that may be responsible for the occurrence of cancer, or studying the fate of transplanted bits of tumors in animals, we must consider the problem in its physiological aspects and elucidate the fundamental relations which unite the development of neoplasms, the proliferative energy of normal tissues, and the functions of the humors.

The mechanisms that bring about the resting condition of the tissues in the adult organism, and allow a resumption of their activity during wound healing or tumor growth, are most complex. However, the experimental analysis of these phenomena has become possible lately. The new techniques, by which fibroblasts, epithelial cells, leucocytes, and tumor cells can be made to grow in pure cultures like bacteria,<sup>1</sup> have brought some light into this obscure field. This paper is intended merely to bring together certain facts that I have observed in studying normal and cancer tissues, and to discuss their significance from both points of view—the formation of tumors, and their growth.

*A Mechanism of the Formation of Malignant Cells*—The transformation of normal into malignant cells takes place under conditions that are far from being accurately known. However it is certain that tumors practically always occur at the site of a chronic irritation, sarcoma appearing

\* Read before the American Surgical Association May 5 1925

during youth, and carcinoma during old age. These simple observations indicate that two factors are necessary for the production of cancer—local irritation, and a certain condition of the tissues and the humors, such as takes place in old age or youth. No specific agent can be held responsible for the formation of a tumor. An immense amount of clinical evidence and the observations of Borrel, Fibiger, Yamagiwa, and others have proven that cancer develops as readily in the focus of a parasitic or bacterial infection as in tissues irritated by X-ray burns or some chemical substances. But, in order to bring about the formation of a tumor, these irritants generally require a certain predisposition of the organism, such as senescence in the case of carcinoma.

Our problem is to discover how local irritation determines a neoplasm and how this phenomenon may be influenced by a general condition of the organism. The study of transplanted tumors cannot give us any information, as we are concerned with the transformation of normal into cancer cells and not with their mode of propagation. Fortunately, it has become possible to observe the genesis of a tumor since Rous found a sarcoma which can be transmitted through its filtered extract. This discovery can be considered the most important advance in cancer research during the last twenty-five years, because it rendered feasible a direct examination of the process of tumor formation. More recently, Yamagiwa also developed an effective method of producing cancer tissue by coal tar. The formation of a neoplasm by this technic is a slow process, while the filtered extract of Rous' sarcoma possesses such activity that the transformation *in vitro* of normal tissue into sarcoma may take place in two days.<sup>2</sup> However, both Rous' substance and coal tar were used in my investigations of the genesis of malignant cells, the role of irritation in the process, and the mechanism of body resistance to tumor formation.

*Transformation of Normal into Malignant Cells by Rous' Principle*—When an extract of Rous' sarcoma, filtered through a Berkefeld filter, is injected into a chicken, a malignant tumor develops which generally kills the animal by lung metastases. The tumor, as is well known, is a spindle-cell sarcoma, which is to-day extremely malignant and may bring about the death of the host in about two weeks. When a fragment of Rous' sarcoma is cultivated *in vitro*, cells of various types migrate into the culture medium. They are chiefly polymorphonuclear leucocytes, macrophages, and fibroblasts. We had to determine whether all these cells are malignant, or whether the malignant characteristic belongs only to one type. From Rous' sarcoma and another chicken sarcoma, pure strains of fibroblasts and of large mononuclear leucocytes (monocytes, blood macrophages, or endothelial leucocytes) were isolated, and after a few weeks their malignancy was tested by inoculation into chickens. The fibroblasts were not found to be malignant,<sup>3</sup> while the pure cultures of macrophages, when grafted into fowls, gave rise to tumors which killed the animals rapidly.<sup>4</sup> Although Rous' sarcoma consists of spindle cells, it appeared that the malignant element is the macrophage.

## FORMATION AND GROWTH OF MALIGNANT TUMORS

The result of these experiments indicated that the inoculation of Rous' substances into the body probably transforms the tissue macrophages into sarcoma cells, while it has little or no action on the fibroblasts. This supposition was tested *in vitro*. Pure cultures of fibroblasts and of blood macrophages were inoculated with the cancer-producing substances. The fibroblasts did not become transformed into malignant cells,<sup>5</sup> while the macrophages did.<sup>6</sup> It was obvious that the macrophages possess a stronger affinity for Rous' substance than the fibroblasts. The Rous sarcoma appears, therefore, to be a disease of the macrophage. In some of Fischer's experiments,<sup>7</sup> where fragments of embryonic heart became sarcomatous from contact with fragments of Rous' tumor, the contamination was probably due to infection of the tissue macrophages by Rous' principle. When heart tissue is inoculated *in vitro* with sarcoma extract, the abnormal migration of the tissue macrophages, which was observed by Ebeling,<sup>8</sup> shows that these cells have been affected by Rous' substance in some manner. But it is not unlikely that under certain conditions fibroblasts can also be infected.

The possibility of transforming a pure strain of normal monocytes into sarcoma has been utilized in the study of the essential characteristics of a malignant cell.<sup>9</sup> Pure cultures of monocytes taken from the blood were made in flat, round flasks and subsequently inoculated with a small amount of filtered Rous' sarcoma extract. After several weeks, the cultures were injected into fowls and gave rise to rapidly growing tumors which ultimately killed the animals by metastasis. It was evident that the monocytes had become sarcomatous. The changes undergone by such cultures may be summarized as follows:

After the inoculation of cultures of monocytes with Rous' substance, most of the cells go on multiplying for days or weeks. But a few macrophages assume the appearance of diseased cells and sometimes agglutinate in clumps. Around the small masses of amorphous tissue, the ameboid cells show less activity, become full of vacuoles and granulations, metamorphose into fibroblasts<sup>9, 10, 11</sup> and eventually die. It seems as if Rous' substance communicates to the monocytes a disease which still allows the cells to multiply, but shortens their life.

When the culture medium is stained with phenol red, it becomes apparent that the tissues infected with Rous' principle manufacture more acid than the controls even before the onset of marked morphological changes.<sup>2</sup> The acid production may be more marked when the medium contains a large amount of glucose and is deprived of air. This agrees with the fact discovered by Warburg that tumor tissue, deprived of oxygen, possesses a high glycolytic power. The production of acid by the cells, as well as their diseased condition, explains the increase of their electrical conductivity observed by Crile. This modification of the conductivity is a characteristic of cell injury, as Osterhout has shown and also of an increase of the H<sup>+</sup> ion concentration in the tissues. It can hardly be considered as specific of tumors.

The cultures are profoundly modified by the production of necrotic tissue



and the digestion of the medium around the amorphous masses. The coagulum assumes the appearance of a geographic map or moth-eaten cloth. There is an abundant production of proteolytic enzymes which later on destroy the medium and eventually kill the cultures. Numerous monocytes become transformed into large triangular, polygonal, or spindle-shaped cells, having sharp processes and filled with granulations. They closely resemble normal or diseased fibroblasts.

During the process, the Rous principle is reproduced, as is demonstrated by the formation of malignant tumors after fowls have been inoculated with the fluid of the cultures.<sup>1</sup>

We may conclude from these experiments that the essential characteristic of a sarcomatous macrophage is to be a diseased and short-lived cell which reproduces the substance responsible for its malignant transformation. The tumor cell is by no means anarchical, nor does it possess as much growth energy as a normal monocyte. It is merely a sick cell. The malignant transformation is not the result of a long process, as cultures of normal spleen have been observed to become sarcomatous in forty-eight hours.

The morphological changes in a pure culture of monocytes under the influence of Rous' principle remind one of the clear areas that Twort observed developing in his cultures of micrococcus after he had inoculated it with the lytic principle, called later bacteriophage by d'Herelle. In those areas, the micrococci underwent lysis and reproduced the lytic principle, and the phenomenon could repeat itself indefinitely. In an analogous manner, the macrophages inoculated with Rous' substance become sick, reproduce the Rous substance, and die. As long as the coagulum contains living cells, the Rous substance is set free in the medium. There is some resemblance between the lytic principle of Twort and the Rous principle. Both can be supposed to develop within a cell under the influence of a metabolic disturbance, caused by a non-specific factor. Once the process has started, it reproduces itself indefinitely by a mechanism that we do not understand, but whose existence is certain.

The properties that we have described as characteristic of the malignant cells of Rous' sarcoma are probably common to all sarcomatous cells. An investigation was made of the behavior *in vitro* of various types of malignant tumors<sup>2</sup> such as carcinoma of the hen ovary, other fowl sarcomas, Flexner-Jobling carcinoma, mouse carcinoma, mouse sarcoma, fowl coal tar sarcoma, fowl teratoma, and human spindle-cell sarcoma. In every case, the cells were less active than normal cells of the same type and died prematurely. The digestion of the medium took place generally in the same manner as in cultures of Rous' sarcoma. A more complete study was undertaken of tar sarcoma.<sup>2</sup> Its cultural properties closely resemble those of Rous' sarcoma. The fragments rapidly surround themselves with polymorphonuclear leucocytes and macrophages. These cells are less resistant than normal leucocytes and monocytes and die in large numbers within twenty-four hours. The digestion of the medium occurs in the usual way. In the digested area, small

clumps of amorphous material, dying macrophages, and large fibroblasts more or less full of granulations and vacuoles are observed. After a few days, the cultures present the same appearance as the cultures of Rous' sarcoma. To summarize there is no fundamental difference between the cultural characteristics of the Rous and tar sarcomas, and most of the properties of the macrophages from both tumors are identical.

We do not yet understand the mechanism of the transformation of normal cells into tumor cells under the influence of coal tar. In spite of the large number of experiments inspired by the discovery of Yamagiwa, little is known beyond the fact that coal tar rubbed on the skin, or injected into the tissues, brings about the formation of a malignant tumor.

In order to analyze this phenomenon more closely, Landsteiner and I attempted to transform a pure strain of fibroblasts into sarcomatous cells by adding small amounts of coal tar to the cultures. The experiments were continued for months. Some morphological changes were observed, but none of the cultures became malignant. Later, I performed similar experiments with macrophages, also with negative results. It appeared that coal tar did not directly induce the transformation *in vitro* of the normal cells into tumor cells and that its mode of action differs in a radical way from that of Rous' substance.<sup>2</sup>

Therefore, I supposed that coal tar could be considered as the probable precursor of a substance analogous to Rous' principle which develops in the tissues of the animal under the influence of two factors, local irritation, and a modification of the blood plasma produced by coal tar. This hypothesis inspired the following experiments.<sup>2</sup> Some chickens, into which Miss McFaul had injected intravenously a solution of coal tar, were inoculated under the skin with a small amount of embryonic pulp. This gave rise to teratomas which were partly sarcomatous, recurred after extirpation, and produced tumor when grafted into other fowls.

This result signifies that the simultaneous action of both factors, embryonic pulp, and a condition of the humors, brought about by intravenous injection of tar, may result in the formation of a tumor. Tar cancer would be a self-perpetuating disturbance of the metabolism created by the action on embryonic cells of a substance contained in the humors and related directly or indirectly to coal tar. The knowledge of this effect may lead to some understanding of the causation of other tumors. It is plausible to think that certain substances produced by bacteria and helminths, or resulting from X-ray burns may determine in macrophages or epithelial cells as does coal tar a disturbance which afterwards propagates itself indefinitely. By a similar mechanism, the toxic substances normally present in the blood during old age might act on the dividing cells of an irritated area as does the serum of tar-injected chickens on embryonic pulp. This simple process would be responsible for the spontaneous production within the organism of malignant tumors.

*Effect of Local Irritation on the Formation of Sarcoma*—Cancer almost

always starts at the site of a chronic inflammation, as every surgeon knows. But this effect of local irritation on the formation of a neoplasm is not yet well understood. Rous has observed that the formation of tumors under the influence of sarcoma extract is facilitated by local irritation. Starting from his experiments, I made a study of the mechanism of the phenomenon. At first, I found that such slight inflammation as was supplied by the presence of a small fragment of woolen cloth in the subcutaneous tissue caused the Rous substance to produce a tumor at a concentration as low as 1 per 50,000, and later that irritative factors of widely different nature increase the effect of Rous' principle on the tissues. As those factors have in common the property of inducing a slight inflammation, possibly their effect is due to the leucocytes attracted to the irritated area, or to the substances secreted by them. These two suppositions were submitted to experimental test.

After the inoculation of some cultures of leucocytes, spleen, and embryonic heart with equal amounts of Rous' filtered extract, the sarcomatous transformation occurred more quickly in the cultures of leucocytes and spleen than in the heart cultures.<sup>2</sup> In other experiments, a small amount of pulp of embryonic tissue was injected into chickens at the same time as Rous' principle. Tumors developed much earlier and were about five times larger than those produced by the sarcoma substance alone.<sup>2</sup>

We also ascertained whether, at body temperature, the presence of embryonic substances increases the duration of the activity of the Rous agent *in vivo*.<sup>2</sup> It is well known, since Rous studied this subject, that the cancer-producing substance is very unstable and loses its activity in a short time at body temperature, when it is dissolved in saline solution and in serum. But in serum, the life of the principle is a little longer than in saline. Recently, I repeated those experiments and confirmed the early results of Rous. Under the present conditions, Rous' substance dissolved in Tyrode solution generally disappears after an incubation of fifteen hours, while it is still active if dissolved in serum. When fresh tissue and embryonic juice are added to the serum, the agent can be preserved several hours longer and, under certain conditions, as long as four days.

The mechanism of local irritation on the formation of sarcoma by Rous' principle can now be understood more clearly. We have to explain by what process a very small amount of Rous' principle fails to produce any effect when injected alone into the tissues, but determines the appearance of a tumor if the tissues are slightly irritated. The failure of the injection into non-irritated tissues can be attributed to the absence of macrophages, and to the lack of susceptibility of adult fibroblasts to Rous' substance. If the sarcoma agent is only in contact with resistant cells, it spontaneously loses its activity within a short time, and no tumor occurs. But if the tissues receiving the injection are inflamed and contain leucocytes and their juices, they become more susceptible to the Rous agent. As the sarcoma-producing substance remains active for a longer time under these conditions, it has still more chance of meeting with susceptible cells which then become malignant.

*Mechanism of the Natural Resistance of the Organism to the Formation of Sarcoma*—When mice are rubbed with coal tar, or fowls are inoculated with diluted Rous agent, some of them develop tumor and others do not. It is obvious that the formation of tumors under the action of a given factor requires a certain predisposition, or lack of resistance of the organism, which can be compared to the susceptibility shown by the tissues of old human beings to the development of carcinoma. Several years ago, Rous discovered that some normal chickens are immune to the inoculation of the filtered extract of sarcoma, while others are not. It is evident that the same cause does not produce the same effect in every animal. Certain individuals are more susceptible than others to the production of tumor. As this is a very important phenomenon, I have attempted to elucidate its mechanism.<sup>2</sup>

First a method was developed by which the resistance of an animal to the Rous principle could be roughly measured. The virulence of Rous' sarcoma has increased so markedly that a small amount of extract injected into an adult chicken always determines the appearance of a tumor. All individuals appear to be susceptible to pure extract. Differences in their resistance are detected only when diluted extract is used. The highest dilution that produces a tumor can be considered as the measure of the susceptibility of the animal. A series of chickens were grafted under the skin with small disks of flannel, soaked in solutions of Rous' sarcoma extract, varying in concentration from 1 per 1000 to 1 per 50,000, and the highest dilution producing a tumor was taken as an index of susceptibility. In some of the animals, all the dilutions, even the highest, determined a sarcoma. In others, no tumors at all were observed, or they only appeared at certain dilutions. According to the concentration of the Rous agent which initiated a neoplasm the animals were distributed into several classes and their susceptibility or resistance was determined in some measure.<sup>2</sup>

The degree of resistance of an individual to Rous' sarcoma seems to be a permanent characteristic. A few chickens that were immune at a first inoculation were injected again three or four times in the course of a year, and remained immune. Other chickens were sensitive and developed tumors which were removed quickly in order to prevent the occurrence of metastases. Some of these animals survived and were inoculated again after a few months. They were as susceptible as after the first inoculation. One of the chief causes of susceptibility to the influence of the Rous substance was age. Young animals are always less resistant than old ones, or than animals affected with any wasting disease.<sup>2</sup>

Since a few apparently normal chickens resist the effect of the Rous substance there is certainly some mechanism which protects the immune or relatively immune animal against the action of the infecting agent. We may suppose that in the less susceptible animals the Rous principle loses its activity under the influence of the humors before it has a chance of infecting the tissues or that the macrophages have less affinity for it than those of susceptible animals or that they are not present in sufficient numbers. The

first hypothesis was verified by testing *in vitro* the effect of the serum of immune and susceptible animals on the Rous agent<sup>2</sup> By treating the serum of a number of animals which were susceptible or immune to sarcoma with a small amount of Rous' principle, incubating it for some hours, and inoculating a fowl with disks of flannel soaked in the fluid, we determined whether the sarcoma principle had lost its activity under the influence of the serum Generally, the agent loses its tumor-producing power more rapidly in the serum of immune than in that of susceptible animals Under the conditions of my experiments, the Rous substance which had been incubated with Tyrode solution, guinea hen serum, duck, or rabbit serum, ordinarily did not produce any tumors When incubated with serum of susceptible fowls, it gave rise to sarcoma Generally the mixture of Rous' principle and serum of immune animals failed to develop a neoplasm, or determined the appearance of a tumor after a longer time It appears, then, that the serum of the susceptible animals differs chiefly from that of non-susceptible animals in being a better preservative medium for the Rous principle In order to arrive at some understanding of this phenomenon, I studied the effect of certain modifications of normal serum on the preservation of Rous' principle<sup>2</sup> When serum had been heated at 70° C, its property of retarding the spontaneous destruction of Rous' substance was practically lost The serum of young fowls was generally found to be a better preservative medium than that of old ones There is probably some relation between the affinity of Rous' principle for macrophages and embryonic cells and its prolonged activity in young serum

Individual susceptibility is partly determined by a certain condition of the humors which depends on the age of the animal, its metabolism, state of health, possibly its diet, and many other factors, especially heredity There are certainly other causes of this phenomenon, but we have as yet no precise knowledge of them The existence of a general condition of the organism, which modifies its resistance to sarcoma, is of great practical importance It is not impossible that a thorough knowledge of the mechanism which brings about resistance may ultimately lead to the development of methods for decreasing the frequency of malignant tumors

*B Mechanism of the Growth of Tumors*—The factors determining the transformation of normal into malignant cells are not identical with those that induce the tumor to grow indefinitely within the organism In order to understand the development of a sarcoma in an adult animal, we must find out what factors prevent the growth of normal tissues

*Regulation of the Growth of Normal Tissues*—It has been generally supposed that tissue growth comes to a standstill when the energy derived from the ovum is exhausted This theory was disproved by a study of the regulation of cell multiplication *in vitro* which disclosed the two following facts fragments of connective tissue taken from an adult animal can be made to proliferate as actively as embryonic tissues,<sup>12, 2</sup> a strain of fibroblasts in the fourteenth year of its life *in vitro* displays the same proliferating activity as embryonic tissue<sup>13</sup> Therefore, it is clear that the growth energy

## FORMATION AND GROWTH OF MALIGNANT TUMORS

of adult connective tissue is not exhausted and that the growth energy of embryonic tissue is unlimited under certain conditions. Another classical theory explains the arrest of growth of adult tissue by the pressure of other tissues. This supposition was also subjected to experimental test. When fragments of connective or epithelial tissues are extirpated from an adult animal and cultivated in serum, the cells proliferate for a while, but their mass does not increase<sup>14</sup>. Freedom from the pressure of surrounding tissues does not give the cells the power of synthesizing new protoplasm from serum.

The dormant condition of adult tissues must be attributed to another cause. As soon as the use of pure cultures of fibroblasts permitted the analysis of the conditions determining growth, I found that the quantity of fibroblasts produced *in vitro* in a given time depends upon the composition of the medium. In serum from an adult animal the multiplication of fibroblasts decreases and finally stops. When embryonic tissue juice is added to the medium, the rate of growth progressively increases until the tissue fragments double in volume every forty-eight hours. In other words, the growth energy of a pure culture of cells is a function of the concentration of the growth-promoting and inhibiting substances contained in the medium<sup>12, 14, 15</sup>.

The growth-promoting substances are contained chiefly in embryonic juices and possess the fundamental property of rejuvenating adult connective tissue and epithelium, and of inducing an unlimited proliferation of both tissues<sup>16</sup>. They are easily destroyed by heating, do not pass through a Chamberland filter, and lose their activity in a short time at body temperature. They are analogous to those present in leucocytes, malignant tumors, and certain adult tissues. They differ from the hormones because they do not merely stimulate growth, but also contain the food material necessary for the synthesis of protoplasm<sup>17</sup>. Embryonic tissue juices have the power to maintain fibroblasts and epithelial cells in a true condition of cultivation and determine an indefinite increase in their volume<sup>14</sup>.

Blood serum, in which cells may proliferate for some time, does not supply fibroblasts and epithelial cells with the food material necessary for the building up of new tissues<sup>14, 18</sup>. It is not a nutrient medium for these cells. Serum also possesses the property of restraining cell proliferation<sup>11</sup>. Its growth-inhibiting power, which is slight in youth, increases progressively during the course of life and becomes very strong in old age<sup>20</sup>. This important property of serum is due to the antagonistic action of two groups of substances: a globulin which is slightly growth-promoting, and a compound of albumin and other substances which is stable, resists heating, and is strongly inhibiting for cell multiplication<sup>21</sup>.

We had to ascertain whether blood plasma and interstitial lymph are endowed with the same restraining power as serum. When a culture of fibroblasts that has multiplied actively for years *in vitro* is grafted into a fowl, its growth stops after a few days<sup>1</sup>. The injection of chick embryo pulp into an adult chicken generally produces a teratoma which ceases growing after a few weeks and acquires a growth energy as low as that of the tissues of the

host.<sup>2</sup> It appears that *in vivo* as well as *in vitro* the humors of the adult organism are inhibiting to cell proliferation. Another proof of the similar inhibiting properties of serum and of plasma is given by the parallel variations in the rate of wound healing according to age, and in the growth-inhibiting action of serum.<sup>2-</sup> We may consider as certain that the inhibiting power of plasma is not markedly different from that of serum.

The organism appears to be protected against any abnormal growth of tissue by a triple mechanism, the lack in blood serum of the food material required by fibroblasts and certain epithelial cells for the synthesis of protoplasm, the growth-inhibiting power of serum, and the instability of the growth-promoting substances that may be set free in the humors. While the inhibiting substances of serum are very stable, do not disintegrate spontaneously at body temperature, and regenerate rapidly, those that promote cell multiplication are stored within the cells and, if they are set free in the humors, lose their activity at body temperature after a short time. It is clear that the organism is well protected against cell proliferation. The knowledge of this mechanism renders still more paradoxical the growth of malignant tumors which takes place in the adult animal in spite of the restraining power of the humors, and the scarcity of the growth-promoting substances.

We have to explain how cells may proliferate within the inhibiting humors. Even in senescence, dormant cells resume their former activity when necessary. Wounds heal and tumors grow as readily in old individuals as in young ones, the only difference being that the rate of cicatrization or of tumor growth is slower when the patient is old. This phenomenon may be attributed to the presence in adult and old organisms of growth-promoting substances which are stored in epithelial cells and leucocytes and can be set free in the humors.<sup>23, 24</sup> When, in the process of regeneration, the tissues must resume their growth activity, the inhibiting effect of blood serum is counterbalanced by substances supplied by epithelial cells and leucocytes. Leucocytes can be considered as mobile unicellular glands which bring to fixed cells the food material they require for their multiplication.<sup>17, 24</sup> Epithelial cells also contain nutritive substances. In the process of cicatrization, the nutrient material necessary for the formation of new cells may come from the leucocytes<sup>24</sup> and the epithelial cells themselves.

*Regulation of the Growth of Sarcoma*—It is probable that a spindle-cell sarcoma grows within the adult organism for the same reasons that a wound cicatrizes, or an organ undergoes chronic inflammation and sclerosis. The hypothesis that tumor cells are anarchical is untenable. There is direct experimental evidence that sarcoma cells cultivated *in vitro* possess the same cultural properties as normal cells, but they are sick and die prematurely. The unlimited growth of sarcoma *in vivo* appears paradoxical when we consider that its growth energy *in vitro* is very weak. However, this phenomenon can easily be explained by the properties which were found to be characteristic of malignant cells. These cells are macrophages which can multiply easily in adult serum. They contain substances that are analagous to embryonic

## FORMATION AND GROWTH OF MALIGNANT TUMORS

trephones<sup>17, 25</sup> and promote cell multiplication. Besides, they invade and destroy anatomical structures such as muscles, which can be used as food material by the growing tissues. The disease that transforms the normal cells into malignant ones is characterized by its self-perpetuating power and a slow cell destruction. One of its effects is to bring about at one point the accumulation of diseased cells, which are stores of growth-promoting substances. It is obvious that if substances capable of inducing cell proliferation are constantly set free in a limited area of the organism, a tumor will develop. Such a phenomenon may explain the multiplication of fibroblasts and other cells in Rous and his sarcoma, and also the abnormal growth energy of cartilage, bone, and epithelium that we observed in experimental teratomas when they became partly transformed into sarcoma. It is clear that the growth of a tumor within the dormant tissues of an old animal does not express an anarchical tendency of a group of cells, but is caused partly by factors analogous to those of normal tissue regeneration.

It is well known that the rate of growth of a tumor of a given type depends on certain conditions of the patients and particularly on their age. Carcinoma develops rapidly in youth and slowly in old age. However, carcinoma belonging to the same histological type will grow at very different rates on people of identical age. It is obvious that the rate of growth of tumors is determined by many other factors than age. On the contrary, the variations in the rate of tissue regeneration in an aseptic wound depend entirely on the age of the patient. The relation between age and rate of wound healing in normal individuals is so constant that the age can be calculated according to du Nouy's equation, when the size of the wound and the rate of healing are known.<sup>26</sup> This phenomenon is due to the fact that in aseptic and non-irritated wounds no factor other than the composition of the interstitial lymph can markedly modify the growth energy of the regenerating tissues. But when a wound is infected, the rate of healing is no longer regulated exclusively by the age of the patient, but by the substances set free by bacteria, pus and necrotic tissue. It becomes very irregular<sup>27</sup> and the curve of cicatrization ceases to be expressed by du Nouy's formula. Under these new conditions, the growth energy of the regenerating cells depends on many complex influences, instead of being regulated by the normal lymph. It is probable that the growth energy of tumor cells is affected in the same manner by the substances set free by more or less diseased tissues and by the variations in the inhibiting action of blood plasma. I found that the interstitial fluid from chicken sarcoma acts on the proliferation of normal tissue in different and often opposite manners. According to the nature and the condition of the tissues it may promote the growth of fibroblasts or on the contrary be toxic for them. The presence of substances from normal and diseased cells and their products of disintegration modify the rate of growth of the tumor itself as they do that of normal tissues.

The rate of growth of sarcoma is regulated like that of wound healing by certain conditions of the plasma which are independent of age. In cachexia



and some forms of general infection, the blood serum contains certain substances which increase its growth inhibiting action. When an abscess develops in the body of a patient having an aseptic wound, the process of cicatrization becomes very slow, and may entirely stop<sup>25</sup>. The same phenomenon is observed in cases of cachexia. When these conditions are reproduced in animals, the serum becomes more growth-inhibiting for fibroblasts<sup>26</sup>. Similar phenomena are observed in the growth of sarcoma. Their rate of growth decreases greatly when the animal becomes sick or is starved, and stops entirely in extreme cachexia. In other words, there is a clear relation between the conditions which regulate the growth of sarcoma, and the rate of growth of normal tissues.

This description of the mechanism of tumor formation and growth is not intended to be an accurate expression of these complex phenomena, in any sense. Neither should my present conception of this process be taken as definitive. The bringing together of facts that are apparently disconnected is merely a convenient procedure for arriving at an understanding of their significance. New phenomena are not of scientific interest unless they are linked with what we already know and open the way to future discoveries. The interpretation of the facts which I have found in the course of my investigations will doubtless be modified. Working hypotheses only last for a short time. Their purpose is not to give an accurate interpretation of what really underlies the complexity of the phenomena but to inspire experiments which will lead us closer to reality.

# REFERENCES

- <sup>1</sup> Carrel, A. Tissue Culture and Cell Physiology. *Physiol Reviews*, 1924, vol. 11, p. 1.
- Carrel, A. The Method of Tissue Culture. Its Bearing on Pathological Problems. *Brit Med J*, 1924, vol. 11, p. 140.
- Carrel, A. Unpublished Experiments.
- <sup>2</sup> Carrel, A. Cultures Pures de Fibroblastes Provenant de Sarcomes Fusocellulaires. *Compt rend Soc de biol*, 1924, vol. 10, p. 1380.
- <sup>3</sup> Carrel, A. La Malignite des Cultures Pures de Monocytes du Sarcome de Rous. *Compt rend Soc de biol*, 1924, vol. 101, p. 1067.
- <sup>4</sup> Carrel, A. Effet de l'Extrait de Sarcomes Fusocellulaires sur des Cultures Pures de Fibroblastes. *Compt rend Soc de biol*, 1925, vol. 101, p. 477.
- <sup>5</sup> Carrel, A. Action de l'Extrait du Sarcome de Rous sur les Macrophages du Sang. *Compt rend Soc de biol*, 1924, vol. 101, p. 1069.
- Fischer, A. En Metode til Dyrkning af Ondartede Svulstceller Ubegrænset udenfor Organismen. *Hospitalstidende*, 1924, vol. 107, p. 169.
- <sup>6</sup> Ebeling, A. H. Unpublished Experiments.
- <sup>7</sup> Carrel, A. Essential Characteristics of a Malignant Cell. *J Am Med Assoc*, 1925, vol. 100, p. 157.
- <sup>8</sup> Carrel, A. Comparaison des Macrophages Normaux et des Macrophages Transformés en Cellules Malignes. *Compt rend Soc de biol*, 1925, vol. 101, p. 584.
- <sup>9</sup> Fischer, A. Cellules Sarcomateuses et Macrophages. *Compt rend Soc de biol*, 1925, vol. 101, p. 392.
- <sup>10</sup> Carrel, A. Contributions to the Study of the Mechanism of the Growth of Connective Tissue. *J Exp Med*, 1913, vol. 17, p. 287.
- <sup>11</sup> Carrel, A., and Ebeling, A. H. Unpublished Experiments.
- Ebeling, A. H. A Ten Year Old Strain of Fibroblasts. *J Exp Med*, 1922, vol. 100, p. 755.

# FORMATION AND GROWTH OF MALIGNANT TUMORS

- <sup>14</sup> Carrel A., and Ebeling A. H. Survival and Growth of Fibroblasts *in Vitro* J Exp Med, 1923, vol xxxviii, p 487
- <sup>15</sup> Carrel, A. Measurement of the Inherent Growth Energy of Tissues J Exp Med, 1923, vol xxxviii, p 521
- Carrel, A. Énergie Intrinsèque et Énergie Résiduelle des Tissus Compt rend Soc de biol, 1924, vol xc, p 66
- <sup>16</sup> Carrel, A. Artificial Activation of the Growth *in Vitro* of Connective Tissue J Exp Med 1913 vol xvii, p 14
- Carrel A., and Ebeling, A. H. Action on Fibroblasts of Extracts of Homologous and Heterologous Tissues J Exp Med 1923 vol xxxviii p 499
- <sup>17</sup> Carrel A. Leucocytic Trephones J Am Med Assoc 1924, vol lxxvii, p 255
- <sup>18</sup> Carrel, A., and Ebeling, A. H. The Multiplication of Fibroblasts *in Vitro* J Exp Med 1921 vol xxxiv p 317
- Carrel, A., and Ebeling, A. H. Action of Serum on Fibroblasts *in Vitro* J Exp Med, 1923 vol xxxvii, p 759
- Carrel, A. and Ebeling, A. H. Action of Serum on Lymphocytes *in Vitro* J Exp Med, 1923, vol xxxviii, p 513
- <sup>19</sup> Carrel, A., and Ebeling, A. H. Age and Multiplication of Fibroblasts J Exp Med 1921 vol xxxiv, p 599
- Carrel, A., and Ebeling, A. H. Heterogenic Serum Age, and Multiplication of Fibroblasts J Exp Med 1922, vol xxxv, p 17
- Carrel, A., and Ebeling A. H. Antagonistic Growth-Activating and Growth-Inhibiting Principles in Serum J Exp Med 1923, vol xxxvii, p 653
- <sup>20</sup> Carrel, A., and Ebeling A. H. Antagonistic Growth Principles of Serum and Their Relation to Old Age J Exp Med, 1923, vol xxxviii, p 419
- <sup>21</sup> Carrel A., et Ebeling, A. H. Mécanisme de l'Action du Serum sur les Fibroblastes Pendant la Vieillesse Compt rend Soc de biol 1924, vol xc, p 172
- Carrel, A. Diminution Artificielle de la Concentration des Protéines du Plasma Pendant la Vieillesse Compt rend Soc de biol 1924, vol xc p 1005
- <sup>22</sup> Carrel, A. Tissue Culture and Cell Physiology Physiol Reviews, 1924 vol iv, p 1
- <sup>23</sup> Carrel, A. Growth-promoting Function of Leucocytes J Exp Med, 1922, vol xxxvi p 385
- <sup>24</sup> Renault J. Traité d'Histologie Pratique, Paris, 1893 vol i, pt 2 p 968
- Jolly J. Le Tissu Lymphoïde Considéré Comme un Tissu de Réserve Compt rend Soc de biol, 1920 vol lxxviii, p 1209
- Cramer, W. Drew A. H. and Mottram, J. C. On the Function of the Lymphocyte and of Lymphoid Tissue in Nutrition Lancet 1921, vol ii, p 1202
- Cramer, A. Vitamins in Health and Disease Lancet 1924 vol i, p 633
- Carrel A. Cicatrization of Wounds XII Factors Initiating Regeneration J Exp Med 1921 vol xxxiv p 425
- Carrel A. and Ebeling A. H. Leucocytic Secretions J Exp Med 1922 vol xxxvi p 645
- <sup>25</sup> Carrel A. et Ebeling A. H. Trephones Embryonnaires Compt rend Soc de biol 1923 vol lxxxix p 1142
- <sup>26</sup> du Nouv, P. L. Mathematical Expression of the Curve Representing Cicatrization J Exp Med 1916 vol xxiv p 451
- du Nouv, P. L. The Relation Between the Age of the Patient the Area of the Wound and the Index of Cicatrization J Exp Med 1916 vol xxiv p 461
- <sup>27</sup> Carrel A. and Hartmann A. Cicatrization of Wounds I The Relation Between the Size of a Wound and the Rate of its Cicatrization J Exp Med 1916 vol xxiv p 429
- <sup>28</sup> Carrel A. Effet d'un Absces à Distance sur la Cicatrization d'une Plaque Aseptique Compt rend Soc de biol 1924 vol xc p 333
- <sup>29</sup> Carrel A. et Ebeling A. H. Indice de Croissance du Serum Saignant Compt rend Soc de biol 1924 vol xc p 170

# THE TRANSPLANTATION OF DISTANT SKIN FLAPS FOR THE CURE OF INTRACTABLE BASAL-CELL CARCINOMA\*

By J. SHELTON HORSLEY, M.D.

OF RICHMOND, VA.

IN 1921 I reported two cases of extensive basal-cell cancer operated upon by following the principle of transplantation of distant flaps for the cure of the cancer (Surgical Treatment of Extensive Basal-cell Carcinoma, *JAMA*, vol. LXVIII, pp. 412-416, February 11, 1922). Since then I have had eight other patients on whom this principle was used. Though some of the operations have been too recent to justify positive deductions as to cure, it may be of interest to analyze this larger group, to consider the principle on which the therapy is based, and briefly to discuss the pathology of basal-cell cancer.

Two general classifications of cancers of the skin have long been recognized—the spinous-cell type and the basal-cell

FIG. 1—(Case I Mr. G. K. P.) Basal-cell cancer involving the upper lip, underlying bone and adjacent structures before operation.

type. There are occasional malignant growths springing from the immediate accessory glands and appendages of the skin—the sebaceous and sweat glands and the hair follicles. The so-called melanotic sarcoma is probably in most cases epidermal in origin. A few pathologists regard basal-cell cancer as arising from the hair follicles, but it is usually considered as beginning in the deep layers of the epidermis, whereas spinous-cell cancer is supposed to originate in the superficial layers. While both of these types admit of much variation in morphology, the extremes of difference appear to be greater in basal-cell than in spinous-cell cancer.

Basal-cell cancer advances with considerable regularity at an almost uniform depth from the surface of the cancer, or

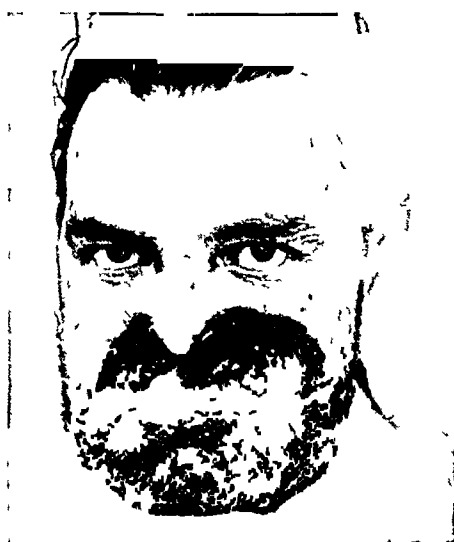


FIG. 2—(Case I Mr. G. K. P.) Sixteen days after operation in which the cancer was cauterized, excised, and the wound was again cauterized. The slough has not yet separated. A flap was outlined on the neck, but this does not show in the photograph.

\* Read before the American Surgical Association, May 5, 1925.

"rodent ulcer," as it was formerly called. Tissues opposing its march are indiscriminately attacked. The deeper layers of skin underlying fat and connective tissue, muscle, periosteum, bone and cartilage are successively invaded in the progress of this disease. It seems to be no respecter of tissue

The cell commonly found in basal-cell cancer is of an oblong or spindle type, sometimes drawn out into a filament. These cells are packed together and may be found in short advancing columns or in isolated groups separated by stroma from the nearby main constituent the surface of the body of similar cells which growth (Figs 4, 9, 10 and 13). It is not infrequent, however, to find widely varying differences in morphology. There may be a tendency toward the development of acini with cubical or columnar cells (Figs 18, 22 and 23). In some basal-cell cancers there is cystic formation, probably resulting from degeneration of central masses of cells (Fig 15). Groups of cells surrounded by columnar cells like those in adamantinoma, or tubular arrangements roughly resembling the tubular glands of the stomach, are forms occasionally seen.



FIG. 3.—(Case I Mr. G. K. P.) A month later. The slough has fully separated. The flap from the neck has been gradually dissected up until all of its nutrition comes from the pedicle and its raw surface has been partly covered by Thiersch graft. The flap was approximated to the raw surface left by excising the cancer after cutting away the Thiersch grafts that interfered with the approximation to the raw surface.

The cause for such wide variations in the morphology and structure of basal-cell cancer is interesting. As basal-cell cancer arises from the deep layers of the epidermis, it is consequently more closely akin to such structures as the sweat and sebaceous glands and hair follicles than would be spinous-cell cancer that springs from the superficial layers of the epidermis. It seems probable that these variations and simulations of gland structure or adamantinomatous cells are reversions due to the closer relation of the basal cell to these glands and hair follicles which are also derived from the deep layer of the epidermis.

It is rather common for spinous-cell cancer, particularly of the more malignant grades, to metastasize in the nearest lymph-nodes, where is meta-

stasis of basal-cell cancer is exceedingly rare and constitutes a pathological



FIG 4—(Case I Mr G K P) Photomicrograph of basal cell cancer in this case. The top shows the cauterized surface of the cancer. Though the cauterization was thorough and the cancer cells had not penetrated deeply the deep layers of cells are still intact which shows the futility of depending solely upon surface cauterization for a cure of extensive basal cell cancer. (X 155.) (This and the preceding two photographs are from the *Journal of the Am Med Assoc* vol LXXXIII pp 412-416 Feb 11 1922 in which the preliminary report of this case was made.)

the enlarged lymph-nodes examined histologically showed the same type of basal-cell cancer. In the late stages of one case there was very marked cystic formation. Finnerud has searched the literature and finds only five other instances of metastasis of basal-cell carcinoma. The reports of some of these five cases are incomplete and in others the histologic examination was not conclusive. Definite proof of metastasis of basal-cell cancer, according to Finnerud, was given in only one case which was reported by C F Beadles (Beadles, C F *Rodent Ulcer*, *Tr Path Soc. London*, vol xlv, p 176 1894).

The rarity of metastasis of basal-cell cancer is so conspicuous, and metastasis from spinous-cell cancer, except from the grade 1, according to the classification of Broders, is so common that this extreme difference calls for consideration. Basal-cell cancer usually occurs in the face above the lower lip and is most

× curiosity. A few cases of well-authenticated metastases of basal-cell cancer have been reported by Finnerud (Finnerud, W *Metastatic Basal-cell Carcinoma of Skin*, *JAMA*, vol LXXXII, No 10, pp 775-778, March 8, 1924), but they are about as rare as the spontaneous healing of cancer, and for purposes of therapy may be disregarded. Finnerud reported from his practice two cases of advanced basal-cell cancer in which there were undoubted metastases in the lymph-nodes of the neck. Both of the patients were operated upon by Phenister. The original growth and



FIG 5—(Case III Mr W T G) Photograph showing basal cell cancer of the left cheek before operation.

## DISTANT SKIN FLAPS FOR BASAL-CELL CARCINOMA

often seen around the eyelids and the nose. The temporal region and behind the ear are also occasional sites for it. These same areas are often attacked by spinous-cell cancer. The cells of these two types of cancer are about the same size, the spinous-cell usually appearing larger, and they have access to the same lymphatics and blood-vessels. If the cells of basal-cell cancer have equal opportunity with the cells of spinous-cell cancer for transportation by the lymphatics, the marked difference in the tendency to metastasize can be attributed neither to the size of the cells nor to anatomical differences in the invaded tissue. The real cause for this difference appears to be due to the great resistance of normal tissues to the growth of basal-cell cancer, whereas for the more malignant grades of spinous-cell cancer such resistance either does not exist or is readily overcome. It is probable that during the growth of basal-cell cancer some product is elaborated which breaks down the resistance of the adjacent tissues but does not affect tissues

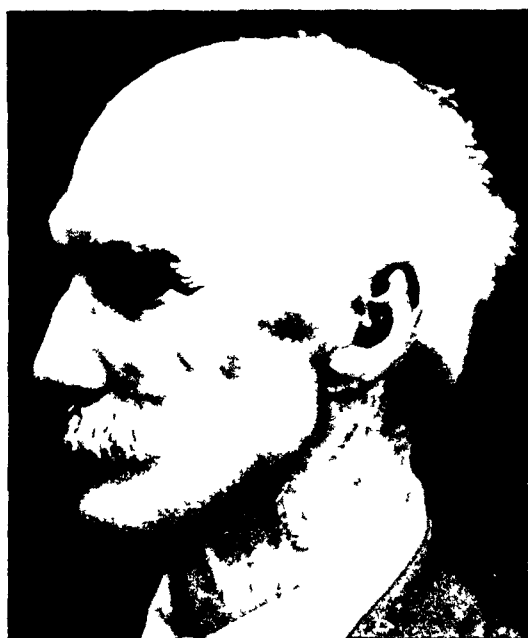


FIG 6—(Case III, Mr. W. T. G.) Photograph taken one year and four months after operation. The transplanted flap from the forehead covers the area of excision and seems to be in good condition.

at a distance. In what manner this substance may act is unknown.

On this hypothesis it seems logical to treat intractable basal-cell cancer by the transplantation of a flap taken at a sufficient distance from the basal-cell cancer to insure that the resistance of the flap to the growth of the basal-cell cancer has not been overcome. This, of course, is only one phase of the operation, but an important phase. Many recurrences after operation for basal-cell cancer are doubtless from the implantation of its cells into the raw surface left by the excision. It is for this reason that treatment with a paste has often been more successful than excision with the knife. The greatest care should be taken to prevent implantation. The surface of the cancer should be well cauterized with the electric cautery, and the excision should be made either with the cautery or else with the knife followed immediately by cauterization of the raw surface. If more rapid healing



FIG 7—(Case III, Mr. W. T. G.) Photograph taken two years and four months after operation. Flap from forehead in the cheek to the inside of the lip when his jaw fully stretched up on the flap. The flap still however unaffected.



FIG 9.—(Case IV, Mr C B) Photomicrograph of basal cell cancer. This shows the type of spindle cells commonly found in basal cell cancer. (X 150)



FIG 8.—(Case III, Mr W T G) Photomicrograph of basal cell cancer. Note the tendency to formation of renal and cystic cavities. (X 150)

is desired, the burnt surface can be dissected off with a sharp knife, leaving a wound ready to receive a graft. When it seems inadvisable to excise the burnt surface, it would be well to postpone the transplantation of the graft for a week or two until the cauterized area has formed granulation tissue.

The depth to which the resistance to basal-cell cancer conferred by a flap extends is difficult to determine. The small blood- and lymph-vessels soon form a network of anastomoses between the raw surface of the flap and the raw surface left by excision of the cancer. Tissue juices of the graft and of the wound would seem to communicate freely on the surface of the wound and probably some communication of these tissue juices extends with decreasing freedom to a depth of a half centimetre. At any rate, there has been no recurrence that originated closer to the transplanted distant flap than about a half centimetre.

Basal-cell cancer in the early stage is often very amenable to treatment. Excision with knife, cautery or paste, or treatment by radium or roentgen-ray, is usually effective. In early cases one of these methods or a combination of them should be adopted. There is how-



FIG. 10.—(Case V, Mrs. J. O. I.) Photomicrograph of basal cell cancer. The cancer cells which show in the right of the picture are long and filament-like. There is a densestroma beneath them and marked leukocytic infiltration. The patient had had extensive roentgenologic treatment. (X 150.)

ever, a small percentage of basal-cell cancers which is not relieved by any of these means. The cancer progresses spreading in all directions at a rather uniform rate from the surface until intervening tissues are destroyed and the bone is eroded. When the mucous membrane is reached the growth seems to become accelerated. Operation in such cases by the ordinary methods of excision is futile. Radiologic treatment apparently does not benefit. It is these cases that offer a field for the transplantation of distant flaps containing tissue whose resistance has not been impaired by the substance evolved in the growth of the basal-cell cancer.

The reaction of basal-cell cancer to flaps transplanted from a distance greatly differs from the action of squamous-cell cancer on transplanted distant



flaps For instance, in the case of Mrs S, who had an extensive spinous-cell carcinoma involving the left ear, transplantation of a flap from the back of the neck and the upper posterior portion of the chest was made to cover the wound left by excision of the cancer There was a recurrence in the tissues of the auditory canal, and the cancer rapidly involved the centre of the trans-

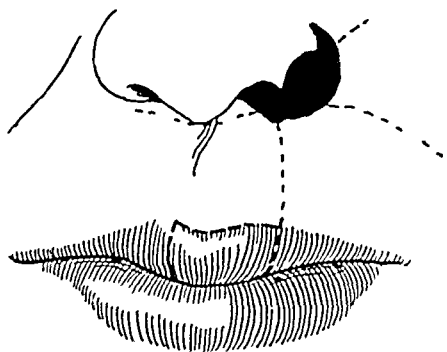


FIG 11—(Case VI Mr O A F) Drawing showing in black the region of the recurrent basal cell cancer and the lines of incision for its exposure and excision at operation

planted flap which was over the auditory canal, growing through the flap and spreading to the surrounding structures In no case where a flap was transplanted from a distance for the cure of basal-cell cancer has there been a recurrence involving the flap or originating in immediate proximity to it, which is in striking contrast to the action of spinous-cell cancer

Of the ten cases that I have operated upon following this general principle of transplantation of a distant flap, two have already been preliminarily reported

CASE I—The first case, Mr G K P, aged forty-nine years, is one of the two cases reported in 1921 He was treated in May and June of 1920 by a series of operations including the excision by cautery of an extensive basal-cell cancer that had destroyed the upper lip and the contiguous part of the upper jaw (Figs 1, 2 and 4) The defect was covered by a flap from the chest with a tubed pedicle, which was raised by dissection in different stages (Fig 3)

This flap was eventually applied to the raw surface left by excision of the cancer About eleven months after operation the patient had a severe attack of cardiac angina of the abdominal type He gradually recovered from this and resumed his work In August, 1922, a small ulcerated area appeared on the anterior portion of the left turbinate bone This was mostly covered with a scab The ulcer was at no point closer to the transplanted flap than a half inch (1.3 cm) and appeared to be independent of the original cancer It was cauterized and excised with scissors and bone forceps and the raw surface was again cauterized with the electric cautery Microscopic examination showed basal-cell cancer similar to the original growth A narrow flap about one and a half inches (3.8 cm)

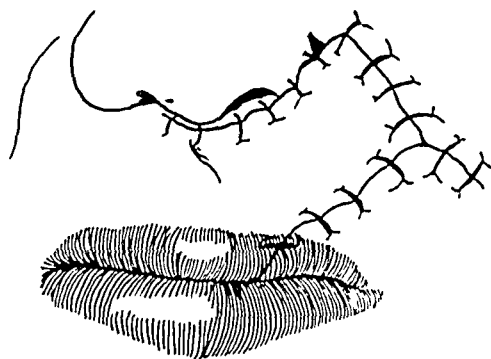


FIG 12—(Case VI Mr O A F) The operation indicated in the previous figure has been completed The tip of the flap on the left cheek was excised and after denuding the under surface the lip is brought over and sutured to this flap In the third operation the scars resulting from the second operation were incised affording satisfactory exposure There has been no recurrence since the third operation

long was taken from the large transplanted flap, mobilized so that its nourishment would not be interfered with, turned into the nostril, and fastened by two silver wire sutures to the raw surface left by removing the cancer The bed from which the flap was raised was closed by undermining the margins of the wound and suturing with fine silkworm gut On February 7, 1924, he died suddenly at a hotel in another city where he was on a business trip There was no necropsy, but it seems probable that the death was from angina The patient was very irregular in reporting for examination, and had not been seen by me for about six months before he died His wife tells me, however, that there was no evidence of the cancer at the time of his death so far as she knew

## DISTANT SKIN FLAPS FOR BASAL-CELL CARCINOMA

This case is interesting because the basal-cell cancer had existed for fifteen years had been operated upon by some very prominent surgeons, had been treated by rontgen-ray, and radium had been applied by one who commands large amounts of radium. The cancer, however, had gradually extended, though there would be intervals sometimes of several months after an operation or treatment in which the growth appeared to be checked.

CASE II—The second case, Miss D B W, operated upon September 28, 1920, was also reported in 1921. She was fifty-five years of age, in bad general condition, with a mitral stenosis. She had a basal-cell cancer that had been growing for twenty years. It began on the nose and progressed until it involved the antium of Highmore. She, too, had had many treatments with the electric cautery, rontgen-ray and large quantities of radium. In an effort to combine a cosmetic operation with



FIG 13—(Case VI Mr O A F) Photomicrograph of basal cell cancer. This is the common spindle-cell type with a tendency for the cells to be drawn into filaments. This is somewhat the same type of cell as shown in Fig 9 (X 150)

a curative procedure, one flap was turned from the neck and another from the forehead, the epithelial surface of one flap being used to fill the antium. As a consequence of these misdirected efforts, portions of the wound from which the cancer was excised were not in contact with the raw surface of the flap. It is interesting to note that at these areas the basal-cell cancer recurred, but at no point where the raw surface of the transplanted flap grew to the raw surface left by excision of the cancer was there any recurrence. The cancer recurred particularly beneath the eye along the orbit and in the palate. She died June 25, 1922.

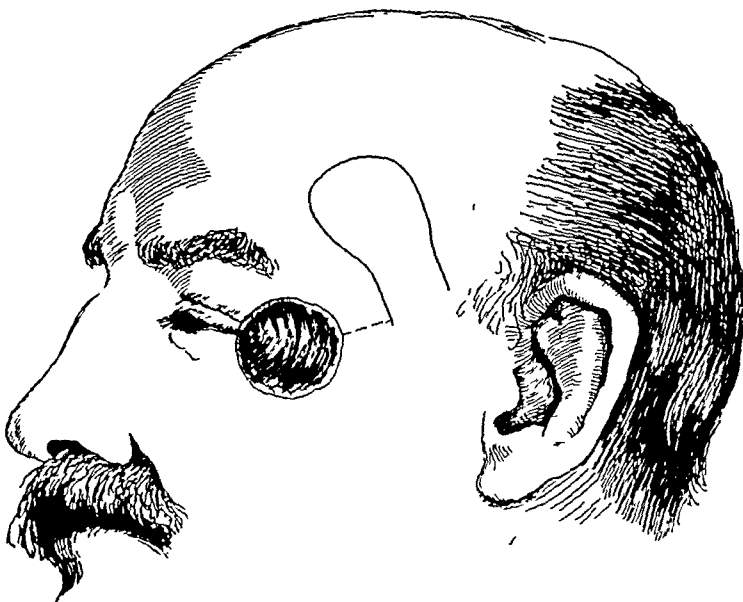


FIG 14—(Case VII Mr E W H) Drawing showing the excised basal cell cancer with the outline of a flap which was transplanted over this area seven days after the first operation

Both of these patients were living when their cases were reported in 1921

The following eight cases have been operated upon since the above two were reported

CASE III—Mr W T G, seventy years of age, noticed about 1910, a growth on the left cheek which he first thought was eczema. It gradually extended and in 1917 broke down and formed a large ulcer. The patient was treated without benefit by an advertising cancer-cure charlatan. A skilled roentgenologist then gave extensive roentgenologic therapy which appeared to check the growth, but it did not heal (Fig 5). On December 10, 1921, I excised a basal-cell cancer from the left cheek with the electric cautery, including



FIG 15 —(Case VII Mr E W H) Photomicrograph of basal cell cancer. The cells are spindle type with many areas in which they are drawn out into filament. The type of cell is somewhat similar to that shown in Figs 9 and 13 though the cells show more degeneration. There are numerous small cystic cavities not lined with any distinctive cells. These cavities appear to be due to degeneration of the cells and are quite different from those shown in Fig. 18 in which there is distinct acinous formation with a lining of cubical cells (X 150)

a small margin of apparently healthy skin. A portion of the malar bone was also removed. A flap from the left frontal region with the base over the zygoma was sutured over the raw surface. The patient made a satisfactory immediate recovery (Fig 6). September 5, 1923 he reported with a recurrence in the cheek to the inner side of the transplanted flap (Fig 7). Under local anesthesia a superficial recurrence in the skin was cauterized and excised with a knife. Beneath this toward the nose was an infiltrating firm mass which proved to be an extension of the basal-cell cancer (Fig 8). Beneath the flap, however there was soft normal tissue and no evidence of recurrence. The growth progressed to the margin of the flap, but did not involve it (Fig 7). As it was quite extensive it could not be completely excised and the wound was left open and the patient was treated with deep roentgen-ray therapy by Dr Fred M Hodges

A letter from him, April 2, 1925, states that the cancer has partly healed in some places but still persists in the inner portion of the left cheek. There is a large fistulous communication with the mouth. The transplanted flap, he reports, has not been involved by the cancer.

CASE IV—Mr C B, aged sixty-one, had noticed a growth about the right ala of the nose in 1912. Various treatments had been applied without benefit. On May 30 1922, I operated upon him, first excising an ulcerating basal-cell cancer with a knife and then cauterizing the raw surface thoroughly with the electric cautery (Fig 9). During the following June a flap was raised from his forehead in different stages, and was transferred to the raw surface left by excision of the basal-cell cancer. In November, 1922, he returned for further plastic operations, no attempt having been made for cosmetic

## DISTANT SKIN FLAPS FOR BASAL-CELL CARCINOMA

effect at first. In a letter from the patient's brother dated April 21, 1925, the patient is reported as being without evidence of recurrence.

CASE V—Mrs J O J, aged fifty-two years, had a basal-cell carcinoma of the left cheek and lower eyelid which began in 1913. She had been treated by rontgen-ray and by radium, which seemed to retard the growth but did not cure it. There was an involvement of the lower left eyelid and the cheek for a distance of about an inch (2.5 cm) below the eyelid. She was operated upon May 4, 1923. The ulcerated area was cauterized with the electric cautery and the left lower eyelid, the adjoining portion of the cheek and a portion of the conjunctiva were excised (Fig 10). A flap was taken from the forehead with the base near the left zygoma, and turned over this area. The patient made a satisfactory recovery. When heard from, April 11, 1925, she was well and had no recurrence.

CASE VI—Mr O A F, aged forty-nine, had at the base of the left ala of the nose a basal-cell cancer which had been present for eighteen months and had been treated by salves and paste. On June 1, 1920, the cancer was cauterized with the Percy cautery and excised

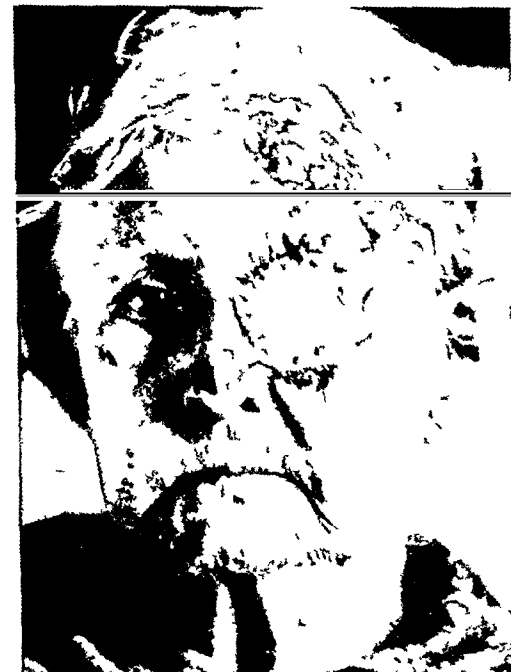


FIG 17—(Case VIII, Mrs A R M) Photograph taken fifteen days after the operation showing the flap transplanted from the forehead and covering the raw surface made by the excision of the cancer. The cauterized area on the left side of the nose is covered with a scab.

with a sharp electric cautery. Superficial portions of the bone were removed with a chisel and rongeur forceps, and the wound was cauterized with the electric cautery and

packed with iodoform gauze. No attempt was made to transplant a flap. May 17, 1923, the basal-cell cancer had returned in the floor of the left nostril. The lip was divided with the electric cautery, which exposed an ulcerated area about  $\frac{3}{4}$  inch (2 cm) in diameter, involving the floor of the left nostril, the underlying bone and the adjacent mucosa of the upper lip. The whole area was thoroughly cauterized with the electric cautery and excised. A tongue-like flap was dissected from the left cheek and the right portion of the upper lip was mobilized as much as possible. The column of the nose and the anterior portion of the septum of the nose were divided. The right portion of the lip was brought into the defect made by removing the ulcer and the quadrilateral tongue-like flap that had previously been made on the left cheek was drawn over. It seemed impracticable to bring over tissue at a further distance from the margin of the wound so that this quadrilateral flap from the cheek, the apex of which had been excised about a half inch (1.3 cm) from the margin of the wound, was united with the right



FIG 16—(Case VIII, Mrs A R M) Photograph of patient before operation. Much of the original growth on the nose has healed except at two small points. The cancer is growing along the inner canthus of the left eye and involves the eyeball and both eyelids.

July 22, 1924, he was operated upon for a recurrence (Fig 13) The lip was



FIG 18 —(Case VIII Mrs A R M) Photomicrograph of basal cell cancer. Note the cysts which are abundant throughout the field. These cysts are lined by a cubical epithelium possibly a reversion to the type of sweat gland. These cysts are quite different from those shown in Fig 15 and are not due to degeneration of cells. (X 150)

incised along the lines of the previous plastic operation. The area of recurrence involved the bone of the superior maxilla at the base of the left nostril and along the alveolar process. The incised margins of the lip were lightly cauterized with the electric cautery and the cancer was thoroughly burned. The ulcerated area was excised with a knife, curette and chisel, and the raw surface was again thoroughly cauterized with the electric cautery. This cauterized area was finally removed with a knife and chisel and a flap of fascia and muscle tissue was made from the under surface of the lip on each side, after reflecting the mucosa. These flaps were brought together in the midline and sutured with catgut over cavity from which cancer had been removed. The lip was sutured over this.

March 5 1925 the patient reported some discharge from the nostril. The nostril was contacted and a view of the internal surface of the nose was difficult. He was referred to Dr F U Wallerstein rhinologist, who examined the nostril carefully and found a small loose spicule of necrotic bone, which he removed. There appeared to be no evidence of cancer.

CASE VI—Mr F W H, aged fifty-nine, about a year previous to admission to the hospital, had noticed a small scab-like growth near the outer canthus of the left eye. This spread, and five months later the patient consulted a physician. Rontgenologic therapy was given over a considerable period of time, but without benefit. The growth had elevated, firm margins, and was in close proximity to the outer canthus of the eye. The actually ulcerated area measured about  $1\frac{1}{4}$  inches (3 cm) in vertical diameter, and about  $\frac{3}{4}$  inch (2 cm) horizontally. January 21 1924 the surface of the growth was cauterized with the electric cautery and excised with a knife, and the resulting wound was cauterized with the electric cautery. A flap was outlined with its base at the left zygoma and the apex on the forehead. The base of the flap was not in



FIG 19 —(Case IX Mrs E Y M) Photograph showing basal cell cancer before operation. The larger growth is on the right temporal region. There is also a smaller lesion on the forehead.

# DISTANT SKIN FLAPS FOR BASAL-CELL CARCINOMA

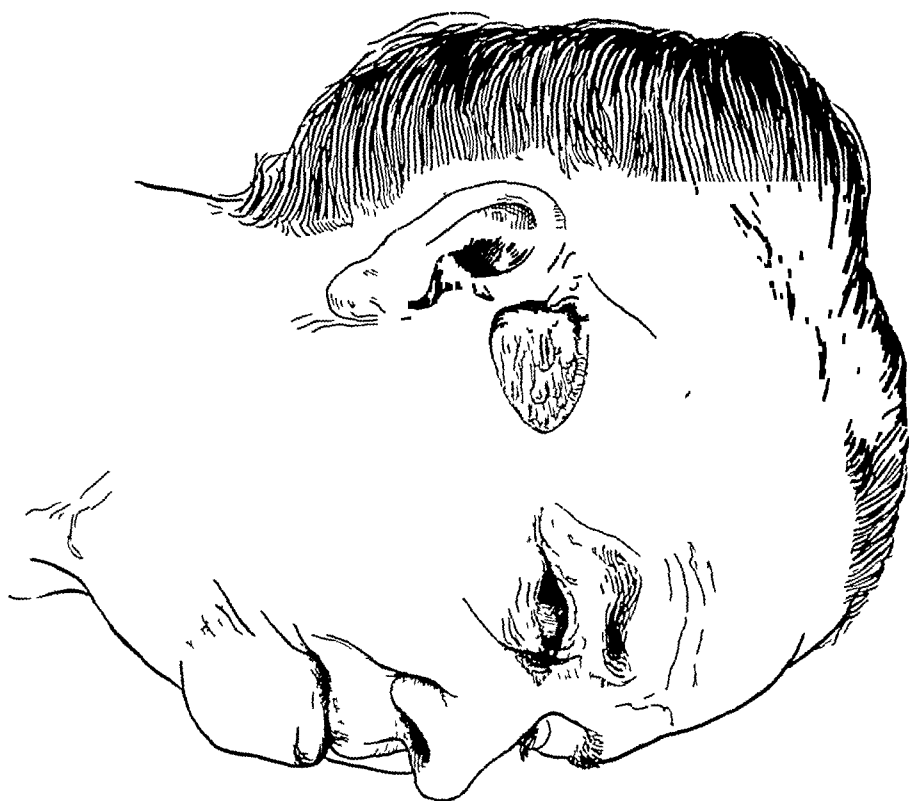


FIG 20 —(Case IX Mrs E Y M) Drawing showing the outline of flap to be transplanted from a distance in order to cover the raw surface left by excision of the basal cell cancer



FIG 21 —(Case IX Mrs E Y M) Drawing showing the flap outlined in the previous figure transplanted and being sutured in position

contact with the margin of the excised wound (Figs 14 and 15) The bridge of tissue between the wound and the base of the flap was divided A week later the flap was turned down and sutured in position It covered all of the wound satisfactorily, except a small area at the inner extremity, where the eyelid could not be fitted accurately to the flap without undue tension

May 12, 1924, a small nodule appeared in the left lower eyelid a short distance from the margin of the transplanted flap but not in contact with it Under local anesthesia this area was cauterized and then excised A plaque of radium was also applied The operation for this recurrence was done by my associate, Dr A I Dobson

His physician, Dr J A Mood Sumter, S C, under date of April 10, 1925, reports there is no evidence of recurrence

CASE VIII—Mrs A R M, seventy-seven years of age, had a basal-cell cancer which began on the nose about 1905 In 1920, she received roentgenologic treatment with some benefit She did not continue the treatment Much of the ulcerated area over the nose had healed, but the cancer on admission to the hospital, October 17 1924 involved the inner canthus of the left eye the adjoining portion of both eyelids and the left



FIG 22—(Case IX Mrs E Y M) Photomicrograph of basal cell cancer This was taken near the margin of the ulcer and shows what appears to be basal cell cancer arising from the deep layers of the normal epidermis at the top of the photograph This is the typical structure of the cancerous growth of the ulcer but the photograph shows what seems to be a basal cell cancer of independent origin in close proximity to the original growth (X 70)

eyeball (Fig 16) The patient's general condition was not good Under local anesthesia the surface of the growth was thoroughly cauterized with the electric cautery There was also a small superficial ulcerated area on the left side of the nose near the tip and a still smaller one on the right side of the nose which were also cauterized The tissues around the inner canthus were dissected from the bone with the electric cautery An incision was made with the knife along the attachments of the eyelids The fat and fascia were dissected from the orbit, the optic nerve was divided with scissors, and all of the tissues, including the inner canthus, the eyeball and the eyelids, was removed in one mass At the site of the lachrymal duct there was a small amount of suspicious tissue left This was thoroughly burned with the electric cautery Four days later a flap was dissected from the forehead with the base in the left temporal region, and was sutured over the raw surface (Figs 17 and 18) The wound on the forehead was covered with sterile vaseline She made a satisfactory recovery Under date of April 10, 1925, she writes that she is well, with no sign of recurrence

CASE IX—Mrs E Y M, aged sixty-five years, had two ulcerated areas of basal-cell cancer, one on the right temporal region just above the zygoma, which was quite extensive, and a small lesion about the middle of the forehead in front of the hairline The ulcer on the right temporal region had existed for eighteen years The patient had

## DISTANT SKIN FLAPS FOR BASAL-CELL CARCINOMA

been treated by a skilled dermatologist, and rontgenologic therapy had been extensively used by a competent rontgenologist. These treatments had extended over several years and there appeared to be a partial healing at one portion of the growth in the forehead (Fig 19). December 2, 1924, the cancer on the temporal region was cauterized and excised, and a flap was formed from the scalp and turned down over the wound (Figs 20, 21, 22 and 23). The frontal lesion, which was small, was excised with the cautery including the pericranium, and the tissues were brought directly together without an effort to transplant a flap from a distance. The wound in the temporal region over which the flaps were transplanted healed satisfactorily. The wound over the forehead broke down and required a subsequent plastic operation. The breaking down, however, was due to tension of the sutures. The patient reported on April 14, 1925, that there was no evidence of recurrence.

CASE X—Mr A J E, aged sixty-three, had a rather

extensive basal-cell carcinoma on the right side of the forehead between the eyebrow and

the hairline. It began in 1909, and had been treated by local applications of pastes and salves. There was a smaller superficial area in the skin in front of the right ear which appeared to be a rather advanced keratosis. December 5, 1924, the region on the forehead was cauterized and excised with the electric cautery. The pericranium, which was adherent to the growth, was also removed. The wound on the forehead was covered by reflecting flaps from each



FIG 23 —(Case IX Mrs E Y M) A higher magnification of the field shown in the preceding figure. The cells are mostly oval. There are numerous small cavities, some of which are partially or completely lined with cubical epithelium and simulate acini. Note the apparent origin from the deep layers of the epidermis. At "A" there seems to be the tip of a deep papilla of the epidermis which may have been cut obliquely making it appear isolated. This apparently isolated area of epithelium seems normal except at the lower portion, where it is continuous with the basal cell cancer. There is similar continuity at the extremity of a papilla from the epidermis shown about the middle of the photomicrograph (X 150)

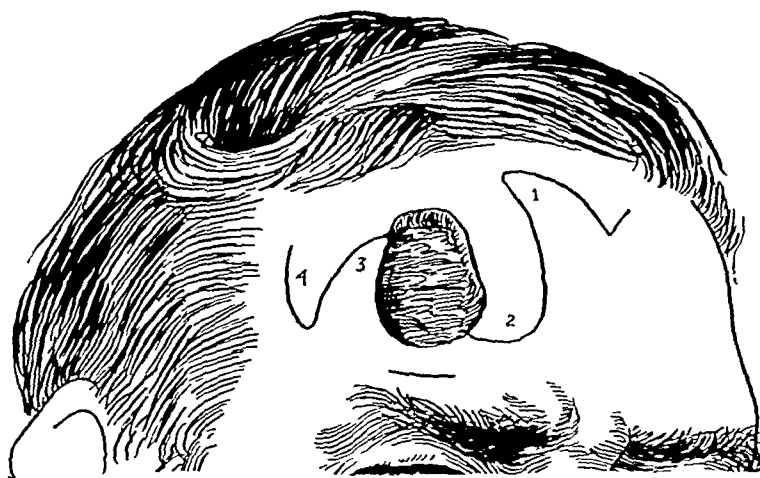


FIG 24 —(Case X Mr A J E) Drawing showing the outline of distant flaps to cover the raw surface left by excision of the basal cell cancer

side of the wound. The flaps were so fashioned that the nearest portion of the flap



to be transplanted was about a half inch (1.3 cm) from the margin of the wound of the excision (Figs 24, 25 and 26). The keratosis in front of the right ear was well cauterized. A portion of the flaps broke down from tension of the sutures and the wound was later closed by a plastic operation in which a flap was slid over the wound. On April 15, 1925, he reported that there was no evidence of recurrence.



FIG. 25—(Case V, Mr. A. J. F.) Drawing showing the flaps outlined in the preceding figure partly sutured in position.

instance has the recurrence originated along the margin of or within the transplanted tissue when the flap was taken from a distance of an inch or more. In Case VI the transplantation of tissues from a distance was not

attempted in the first operation and very imperfectly carried out in the second operation. At the second operation removal of bone from the floor of the nostril left a deep defect, and at the time it seemed better to cover it by approximating the tissues from the margin of the wound, even though the distance was not sufficient, than to transplant a flap which was difficult to fit accurately into this defect. This was an error. Since the third and last operation, on July 22, 1924, in which flaps of fascia and muscular tissue from the lip with their bases along the margin of the wound were sutured together

#### SUMMARY

The striking thing about this series of cases is that, though there has been a recurrence in five in no



FIG. 26—(Case X, Mr. A. J. E.) Photomicrograph of basal cell cancer. The cells are small and oval. There is a tendency toward tubular arrangement (X 150).

over the excised cancer, there has apparently been no recurrence, though a small piece of dead bone, probably the result of cauterization, was removed.

## DISTANT SKIN FLAPS FOR BASAL-CELL CARCINOMA

The efforts in Case II to make a cosmetic as well as a curative operation were unfortunate. In no place where the raw surface of the transplanted flap was in contact with the raw surface left by removing the cancer was there a recurrence. The recurrences were where the skin surface of the transplanted flap was apposed to the raw surface left by excision of the cancer, or where no union occurred between apposed raw surfaces. In the other three instances (Cases I, II and VII) the recurrence was not nearer than a quarter of an inch ( $\frac{1}{2}$  cm) from the margin of the flap. In one of these, Case VII, the recurrence was in the lower eyelid near a point which the flap did not satisfactorily cover. Since it was excised there has been no further recurrence. In Case III, there is an extensive recurrence in the inner portion of the left cheek. It began a short distance from the margin of the flap. But even though the recurrence has been extensive and still exists, the flap has so far not been affected. On the other hand, in a case of squamous-cell cancer a flap taken some distance from the cancer was quickly involved in the recurrence of the cancer.

Such instances as these appear to indicate that flaps when transplanted from a distance have a distinct inhibitory effect upon basal-cell cancer. Just how deep this inhibitory effect extends it is difficult to say—probably an eighth to a fourth inch (3 to 6 mm). This suggests a new principle for the treatment of intractable basal-cell cancers that have not been cured by other measures.

# MALIGNANT TUMORS OF THE THYROID\*

EPITHELIAL TYPES

By ALLEN GRAHAM, M D

OF CLEVELAND, OHIO

FROM THE DEPARTMENT OF SURGERY AND OF PATHOLOGY, LAKESIDE HOSPITAL AND SCHOOL OF MEDICINE,  
WESTERN RESERVE UNIVERSITY

THE clinical diagnosis of malignant tumors of the thyroid at a stage sufficiently early to offer a fair prospect of cure by surgical or other therapeutic measures is still an interesting, important, and, as yet, unsolved problem. Fine distinctions as to the type of malignancy present have proved to be very

uncertain. It has been the accepted custom in dealing with the clinical aspects of malignant goitre to catalogue the symptoms and signs by which malignancy could be recognized. This procedure, however, is of little practical value since there are few if any, ultimate cures in the fifty per cent of cases in which a positive diagnosis is made and verified. Moreover, in the other fifty per cent of cases there are neither symptoms nor signs sufficiently distinctive to warrant a positive differentiation between a benign and malignant lesion. In view

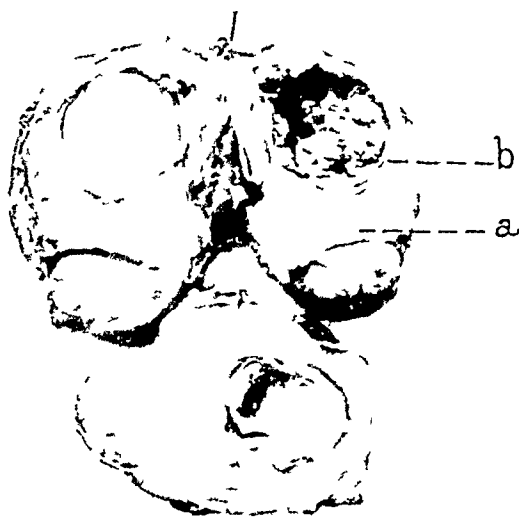


FIG 1—S. P. No. 11085. a. Scirrhus carcinoma.  
b. Degenerating calcareous adenoma.

of the foregoing, we shall make no further reference to the clinical aspects of the subject directly. Indirectly, however, it is believed there may be something of interest to the clinician to be derived from a clearer understanding of the pathology of these lesions.

Those who have had to deal with malignant tumors of the thyroid pathologically know from personal experience some of the difficulties encountered. Those who have sought to solve these difficulties by reference to the literature no doubt have been impressed by the great state of confusion, the endless conflict of authoritative opinion, the hopelessly involved terminology, the lack of satisfactory classification, and the inadequacy of the criteria by which to recognize malignancy in a fairly high percentage of cases.

Perhaps this is not surprising when one considers that the total experience with malignant disease of the thyroid is still comparatively small. A more probable explanation is to be found in the fact that the thyroid has certain peculiarities in regard to its malignant tumors not commonly encountered in

\* Read before the Baltimore City Medical Society, April 3, 1925.

## MALIGNANT TUMORS OF THE THYROID

other organs or tissues of the body For example In no other organ of the body do malignant tumors of epithelial origin proceed so directly on the basis of a preexisting benign tumor (adenoma) as is the case in the thyroid, in no other organ do malignant epithelial tumors (except chorio-epithelioma) exhibit such a high incidence of metastases through the blood stream, in no other organ does the histological appearance of the cells and tissue, both of the primary carcinoma and of its metastases, so closely resemble benign parent tissue, in such a significant percentage of cases

In 1923, Joll<sup>1</sup> tabulated from the literature forty-four cases of metastases to bone from thyroids that were said to be, or thought to be, normal or benign That a primary malignant epithelial tumor, or its metastases, may resemble normal thyroid gland † we emphatically wish to deny That both the primary tumor and its metastases may resemble benign thyroid lesions, histologically, has been amply attested, and is in accord with our experience

Another example of the unsatisfactory state of the literature is to be found in this frequently quoted set of incomprehensible contradictions

The thyroid may be malignant and give metastases that are malignant  
The thyroid may be malignant and give metastases that are benign  
The thyroid may be benign and give metastases that are malignant  
The thyroid may be benign and give metastases that are benign

Equally perplexing is the great variety of names and combinations of names used to describe individual tumors and types of tumors Wilson,<sup>2</sup> 1921, gives the following "Principal tumor types" under illustrative cases

Malignant papilloma,  
Non-malignant papilloma,  
Adenopapilloma,  
Adenopapilloma (malignant),  
Medullary carcinoma,  
Adenomedullary carcinoma,  
Scirrhus carcinoma,  
Scirrhus adenocarcinoma,  
Mixed-cell sarcoma,  
Spindle-cell sarcoma,  
Alveolar sarcoma suggesting epithelial relationship,  
Carcinoma sarcoma,  
Round- and giant-cell adeno-sarcoma,  
Small round-cell sarcoma,  
Adenocarcinoma  
Malignant adenoma,  
Proliferating embryonic (fetal) adenoma, malignant,  
Proliferating embryonic (fetal) adenoma,  
Proliferating embryonic (fetal) adenoma, fibrous degeneration  
Non-malignant adenoma,  
Non-malignant cystic degenerating adenoma,  
Degenerating calcareous adenoma,  
Doubtful

---

† Those who have reported metastasizing normal thyroids, and metastases resembling normal thyroid, have not made the distinction between normal thyroid gland and adenomatous thyroid tissue

Considering only epithelial tumors, the two foregoing examples of the confused state of our knowledge are directly or indirectly the natural outcome of the long-standing conflict between what might be termed the morphological and the biological interpretation of the concept carcinoma, as applied to thyroid tumors. According to the morphological view, there must be sufficient variation from the normal in the cells themselves, or their environmental relationships before the term carcinoma is properly applicable. According to the biological view the natural history of a tumor, its behavior

and effects, are matters of more importance than the size, contour, or functional qualities of cells, recurrence, metastasis, and death of a patient from the disease would be sufficient warrant for use of the term carcinoma irrespective of histological appearances otherwise. The solution of the problem in this particular instance is to be found in a clear conception of the relationship that exists between adenomata and carcinomata of the thyroid.



FIG. 2 — Scirrhous carcinoma (Fig. 1-1) ( $\times 150$ )

Almost all authors who have undertaken to classify the malignant epithelial tumors of the thyroid pathologically have fallen into the error of trying to separate these tumors into two presumably distinctive groups. One of these groups has been carcinoma, with its various subdivisions such as medullary, scirrhous, adeno, alveolar, cylindrical-cell, papillary, etc. The other, and somewhat smaller group, has been designated by the use of such terms as malignant adenoma, adenoma with metastasis, metastasizing adenoma, wuchernde struma, metastasizing simple or colloid goitre, and even metastasizing normal thyroid. The difficulty of such a grouping becomes perfectly obvious in those not infrequent instances when every single one of the aforementioned designations is properly applicable to individual tumors, or to a few selected tumors.

In a previous publication<sup>3</sup> we have pointed out that these two supposedly distinct groups are really different phases of the same fundamental pathological process, namely, the transformation of benign to malignant adenoma. This we can show objectively in at least ninety per cent of all cases. In the remaining ten per cent we can neither prove nor disprove the adenomatous origin of carcinoma. These facts, together with certain collateral observations

## MALIGNANT TUMORS OF THE THYROID

to be mentioned later, have furnished a basis for a conception of malignant epithelial tumors of the thyroid which has been of the greatest practical service from the standpoint of pathological diagnosis, classification, recognition of malignancy, and the adoption of a simple, and at the same time adequate nomenclature. Furthermore, it is believed that there is now available a satisfactory basis for the reconciliation of many of the conflicting views still prevalent.

While this paper deals primarily with malignant epithelial tumors, it may not be amiss to mention sarcomata for the following reasons: (1) The bearing their occurrence may have upon the relative incidence of mesoblastic and epithelial malignancy. (2) Because of the small number of tumors, the malignancy of which is never in doubt, in which it is very difficult to determine positively whether a particular tumor is a sarcoma or a carcinoma. (3) Because of the fact that there are too many cases reported in the literature as sarcomata.

It is interesting to note that Ehrhardt,<sup>4</sup> 1902, reviewed the literature and was able to collect 150 carcinomata to 99 sarcomata. Muller and Speese,<sup>5</sup> 1906, collected 181 carcinomata to 117 sarcomata,

including their own cases. In each of these two reviews there were sixty per cent carcinomata to forty per cent sarcomata. This is an astonishing incidence of mesoblastic tumors to occur in an organ which is noted for the extraordinary range of physiological and pathological variations of its epithelial elements. Wilson,<sup>2</sup> 1921, reviewed the literature and was able to collect, with the addition of personal communications from American surgeons and the material at the Mayo Clinic, 991 epithelial to 195 mesoblastic malignancies, a proportion of 84:16.

About three years ago the writer undertook to review the literature of sarcomata and was thoroughly convinced that up to 1906 a very high percentage of cases reported as sarcomata were typical examples of malignant adenomata.

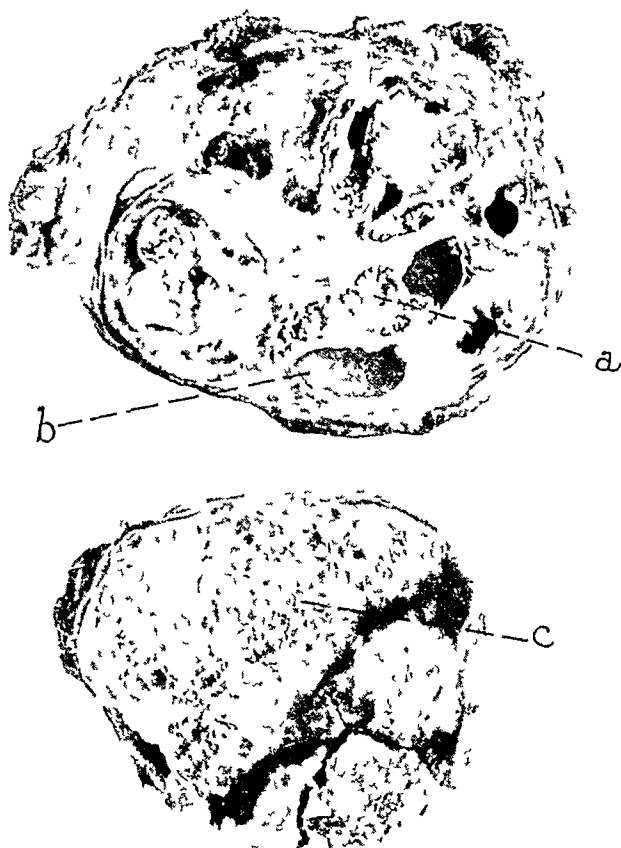


FIG 3—S P No 5943 Papillary carcinoma a Papillomatous growth b Cystic spaces c Benign colloid adenoma

The basis of this report is the material available at the Lakeside Hospital from 1905 to 1922, and includes the records of 134 patients. In twelve, a clinical diagnosis of malignancy was made, but tissue was not examined. In

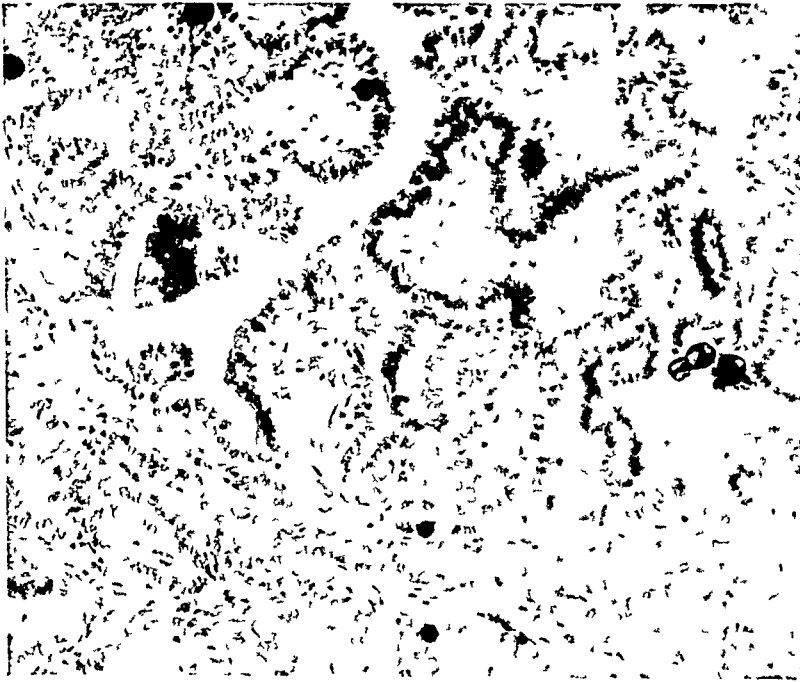


FIG 4—Papillary carcinoma (Fig 3 a) (x 150)

the 122 tumors examined pathologically there were 1 parastroma, 10 sarcomata, 3 tumors at present classified as carcinoma-sarcoma, and 108 epithelial tumors. Slightly less than two per cent of thyroids examined in the laboratory (1915 to 1922—Lakeside Surgical division only) have been malignant.

In the following discussion the 108 epithelial tumors only will be considered. Such comparatively rare lesions as primary squamous-cell carcinoma, the glycogen containing parastroma of Kochei, and the stroma post-brachialis of Getzowa are expressly excluded since they do not originate from thyroid epithelium and are not cognate to the problem under discussion.

It is our purpose to divide these 108 epithelial tumors into groups sufficiently distinctive to be worthy of recognition as types, pathologically, to apply an appropriate designation to each type, and, finally, to submit a basis for the differentiation of benign and malignant adenomata.

On the basis of gross and microscopic anatomy, the 108 epithelial tumors fall readily into the types mentioned on p 6. It is to be emphasized that all of these tumors, in the past, have been



FIG 5—S P No 10937 Carcinoma malignant adenoma type

## MALIGNANT TUMORS OF THE THYROID

diagnosed and considered, by the writer and others, to be malignant, chiefly on histological grounds

- 2 Scirrhus carcinomata
- 8 Papillary adenocarcinomata,
- 55 Carcinomata of malignant adenoma type,
- 43 Adenomata formerly considered malignant, now classed as benign

*Scirrhus Carcinomata*—The tumors included in this group conform to the type so well described by Billroth,<sup>6</sup> 1888, and are not to be confused with malignant adenomata in which there may be areas of dense fibrous tissue,

or scant containing compressed epithelial cells arranged in strands or small islands. These lesions are exactly comparable to similar tumors in other organs and present no pathological problem peculiar to the thyroid. They are easily diagnosed and classified from their gross and microscopic characteristics. According to Billroth, they so closely resemble scirrhus of breast as to require no detailed description.

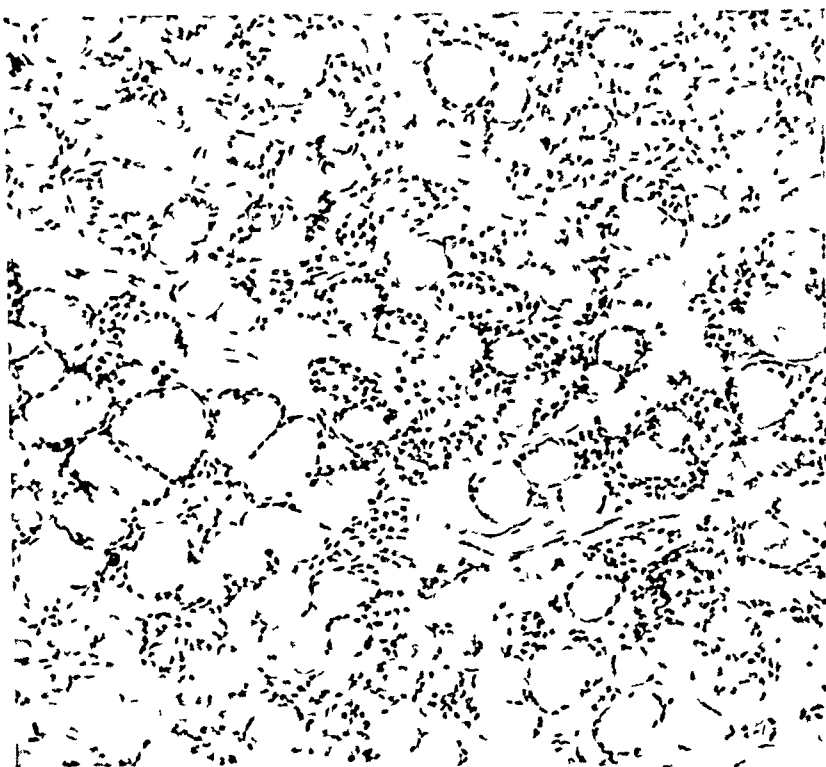


FIG 6—Uninvolved thyroid surrounding the malignant adenoma (Fig 5) ( $\times 150$ )

In this group of cases (Figs 1–2) the thyroid is usually not greatly enlarged, the tumor is not encapsulated, it destroys the affected thyroid, invades surrounding tissue, especially the larynx and trachea, and sometimes the oesophagus. It spreads by direct extension and metastasis to neighboring lymph-nodes. The tumor is hard, fibrous, adherent, immovable, and on section is uniform in consistency and structure. The only lesion with which these tumors can be confused grossly is chronic thyroiditis of the Riedel struma type, or perhaps spindle-cell sarcomata. Microscopically, there is everywhere a great preponderance of fibrous tissue in which are distributed the small masses, cords, or strands of epithelial cells. By the time the patient seeks relief the clinical diagnosis is usually positive, or at least suspected. At operation the surgeon does not remain long in doubt. The tumor cannot be removed without the sacrifice of vitally important structures, hence there are no clinical cures.

This is the one type of carcinoma which we have not been able to associate



definitely with adenoma as regards origin, although the thyroid was adenomatous in each case. So far as our limited experience goes, these tumors

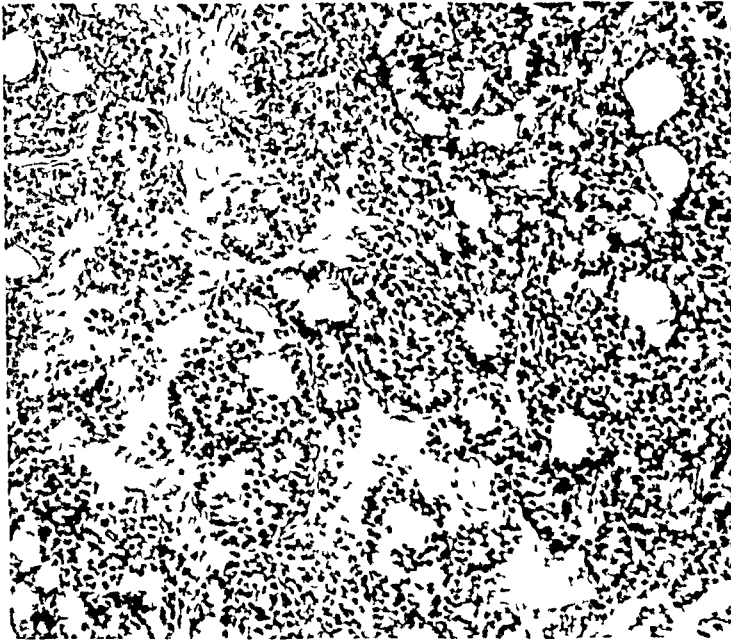


FIG 7 —Adenomatous or adenocarcinomatous area in the tumor shown in Fig 5. (x 150)

do not invade blood-vessels. This is in striking contrast to malignant adenomata, and is in accord with the observation that metastases to distant organs rarely occurs.

*Papillary Adenocarcinomata*—At the outset it may be stated that a distinction is made between those tumors which grossly and microscopically are made up of papillomatous growths (Figs 3-4), usually in connection

with a cyst, and those solid adenomata in which there may be areas of papiferous tissue, microscopically but not grossly, somewhat similar to the type of change seen in thyroids from exophthalmic goitre patients. The former only are classified as papillary carcinomata, the latter are classed as malignant adenomata. Metastasis from the former is chiefly through the lymphatics, while metastasis from the latter is primarily through the blood stream, and through the blood stream only as long as the original tumor is still within its own proper capsule. The former exhibit a low order of malignancy, while



FIG 8 —Medullary carcinomatous area in the tumor shown in Fig 5 (x 150)

## MALIGNANT TUMORS OF THE THYROID

the latter, as a class, are highly malignant. For the foregoing reasons, it is important to preserve the distinction between these two types of lesions.

Of eight cases included in this group, six originated in preexisting adenomata. In the other two cases we can neither prove nor disprove adenomatous origin, although the thyroid was adenomatous in each case. The six cases originating in adenomata were cystic and definitely encapsulated, although the capsule was grossly or microscopically invaded in each case. The two cases in which we can neither prove nor disprove adenomatous origin were small lesions not more than 1 cm in diameter, solid, non-encapsulated, and made up microscopically of adenopapilliferous tissue.

Possibly in the future, as a result of further experience, it may be deemed appropriate to separate the eight tumors under discussion into two distinct groups, but for present purposes they will be considered together.

Pathologically, the malignancy of

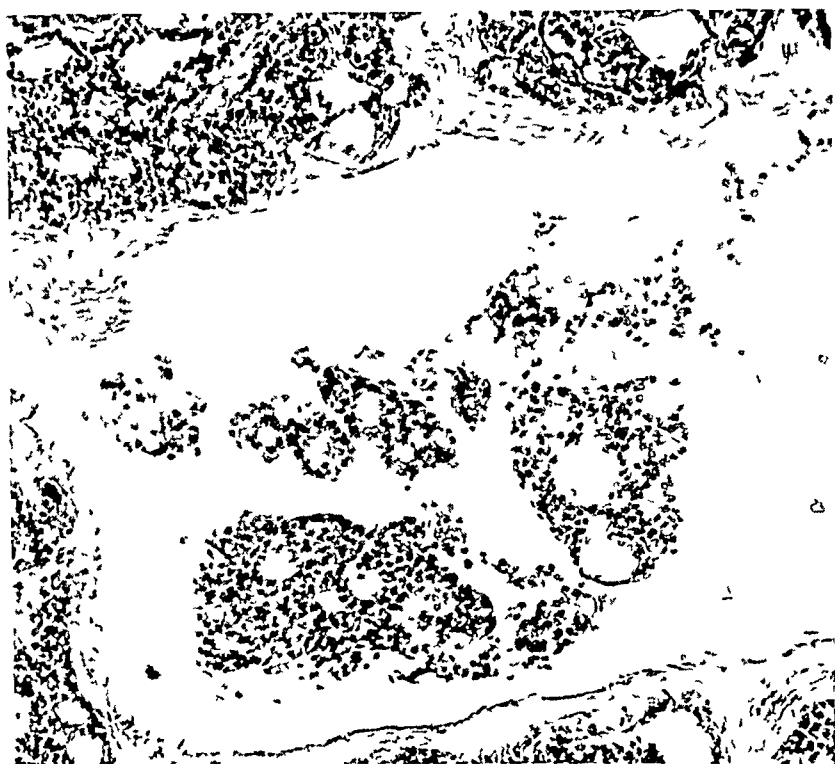


FIG. 9.—Adenomatous tissue within a vein of the tumor shown in Fig. 5 (x 150)

these tumors is evidenced by local invasion, grossly or microscopically, of the capsule, surrounding thyroid or neighboring structures, and metastasis to regional lymph-glands. Metastasis to distant organs has not been observed, and this is in accord with the fact that we have been unable to demonstrate invasion of the blood-vessels in any case.

The pathological diagnosis of carcinoma in this group of cases rests on the demonstration of local invasion, and not on the character of the cells primarily.

From the standpoint of treatment and prognosis, this is the most favorable group of carcinomata of the thyroid. In two cases small solid tumors, not exceeding 1 cm in diameter, were well confined within the lateral lobes. From their size and position, they could not possibly have caused any clinical symptoms, and were discovered in the course of routine examination of supposedly benign goitres removed by operation. These patients are living and well eleven and eight years, respectively, after operation. Of the six cystic papillomatous tumors, two were diagnosed, or suspected as malignant

before operation. The tumors were removed in five cases, in the sixth case exploratory operation was done, but the tumor could not be removed, and only a small piece of tissue was excised for microscopic examination. This patient



FIG 10—Cancer tissue within vein of tumor shown in Fig 5 ( $\times 150$ )

died a few weeks after discharge from the hospital and is the only recorded death in this group of eight cases. In the five cases in which the tumor was removed, the operation performed was usually of such a nature as to offer little or no

prospect of cure in any other type of malignant tumor of the thyroid. That is to say, the cystic tumor was ruptured, cut into, or removed in pieces and in some cases incompletely removed. In spite of this circumstance and later apparent recurrence (in some cases), the tumor has shown a remarkable tendency to remain localized in the neck. Then further progress has seemed to be held well in check by means of X-ray and radium therapy. The ultimate outcome in those patients with obvious recurrence is a matter for the future.

*Malignant Adenomata*—It is to be understood that the tumors in this group are considered to be carcinomata, and that the term malignant adenoma is used to designate a type of thyroid carcinoma. The only carcinomata of the thyroid originating in adenomata not included in this group are six papillary carcinomata. The reasons for their exclusion have been noted above. Malignant adenomata constitute about eighty-five per cent of all carcinomata of the thyroid, and, therefore, are the most important type of malignancy.

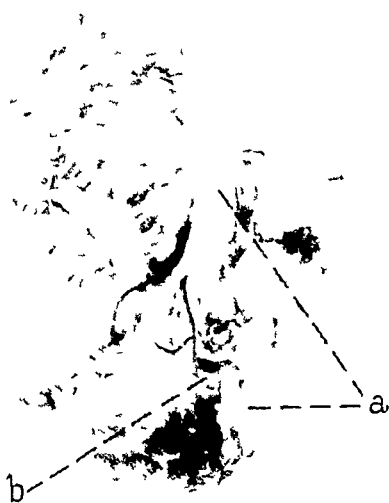


FIG 11—S P No 10777 Malignant adenoma. The opened thyroid vein (a) shows an area of gross erosion (b) of vein wall.

## MALIGNANT TUMORS OF THE THYROID

In this group of 55 malignant adenomata (Figs 5-12) we find every conceivable form, stage and degree in the growth, differentiation, and degeneration of fetal, inter-

mediate or mixed and colloid adenoma. Furthermore, we find all grades of transition of the original adenoma into every supposed type and combination of carcinoma mentioned in the literature, except pure papillary and pure scirrhous carcinoma. For this reason there is an endless variety of histological pictures to be encountered in the group and in individual tumors. The histo-pathological character of the tumors when seen at

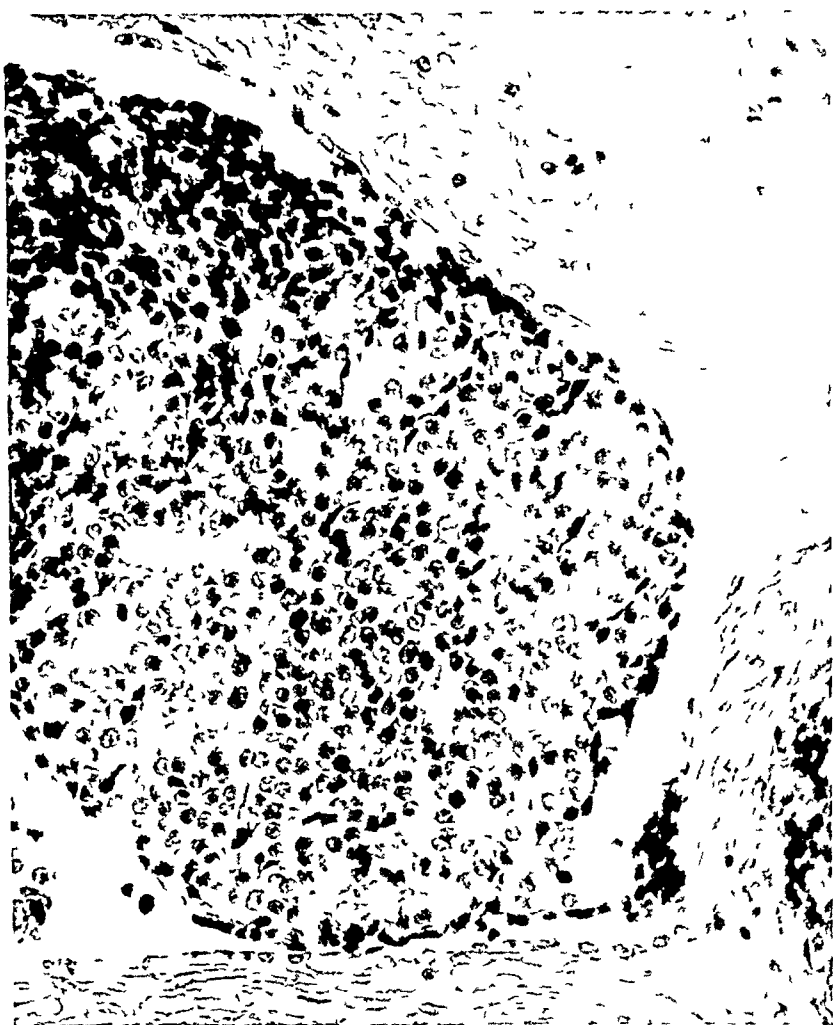


FIG 12 —Thrombus in thyroid vein of malignant adenoma shown in Fig 11 ( $\times 300$ )

operation or autopsy depends upon a num-

ber of factors, among which may be mentioned The character and condition of the original adenoma, the duration of the lesion, the rate of growth, the

character and degree of reaction simultaneously or subsequently initiated in the supporting stroma, scar, or capsule, the blood supply, and the degenerative changes that have taken place. There may be, and doubtless are, other factors difficult or impossible to evaluate. It is further to be noted that in a

large majority of cases the ultimate histological picture is a



FIG 13 —S P No 12093 Benign adenoma formerly considered malignant. a Hemorrhagic fetal adenomatous area. b A more cellular area.

mixed and not a pure type. That is to say, that in a given single tumor there

may be areas of tissue having the microscopic appearance of pure fetal adenoma, more or less intimately admixed with areas of medullary carcinoma, adenocarcinoma, scirrhous carcinoma, papilliferous carcinoma, spindle-cell carcinoma, carcinoma resembling sarcoma, wuchernde struma, and all the other names that have been applied to adenomata that give recurrences or metastases, and result in the death of a patient. In short, one may find microscopically in these tumors any and every variety of benign, malignant, or metastasizing epithelial growth, except normal thyroid gland.



FIG 11.—The uninvolved thyroid surrounding the tumor shown in Fig 13 (x 150)

In view of the foregoing it seems totally illogical to attempt to separate the essential entity malignant adenoma into a number of artificial groups, supposedly types which in themselves with rare exceptions, are not pure lesions. At least, it is certainly impracticable, and has been responsible for much of the confusion that exists.

As for the recognition of the type of malignant tumor

under discussion, one may, for the sake of emphasis, utilize this simple but effective rule. If the tumor is not grossly and microscopically papillomatous (Figs 3-4, and if it is not grossly and microscopically scirrhous carcinoma (Figs 1-2), then it is malignant adenoma (Figs 5-12). However, one must admit the possibility of a carcinoma of the thyroid not originating in an adenoma, and neither of the scirrhous nor papillary type. In view of all the facts now available, the probability of such an occurrence must be extremely small.

Since carcinomata of the malignant adenoma type originate in a pre-existing benign tumor (adenoma), they are always, in the beginning, encapsulated lesions. When tumors of this type have penetrated or perforated their capsule, they may spread by direct extension to surrounding tissues, or through the lymphatics to regional lymph-nodes. The clinical recognition of involved lymph-nodes may be taken as an indication that the primary tumor was not encapsulated, or that the capsule has been penetrated or perforated.

## MALIGNANT TUMORS OF THE THYROID

We have found no exceptions to this rule. As long as these tumors are confined within their own proper capsules there is no dissemination through the lymphatics.

The chief mode of metastasis from malignant adenomata is through the blood stream, with or without intact capsule. Division, during operation, of thrombosed thyroid veins accounts for local recurrence in the neck after what seems to be complete and satisfactory extirpation of tumors well encapsulated.

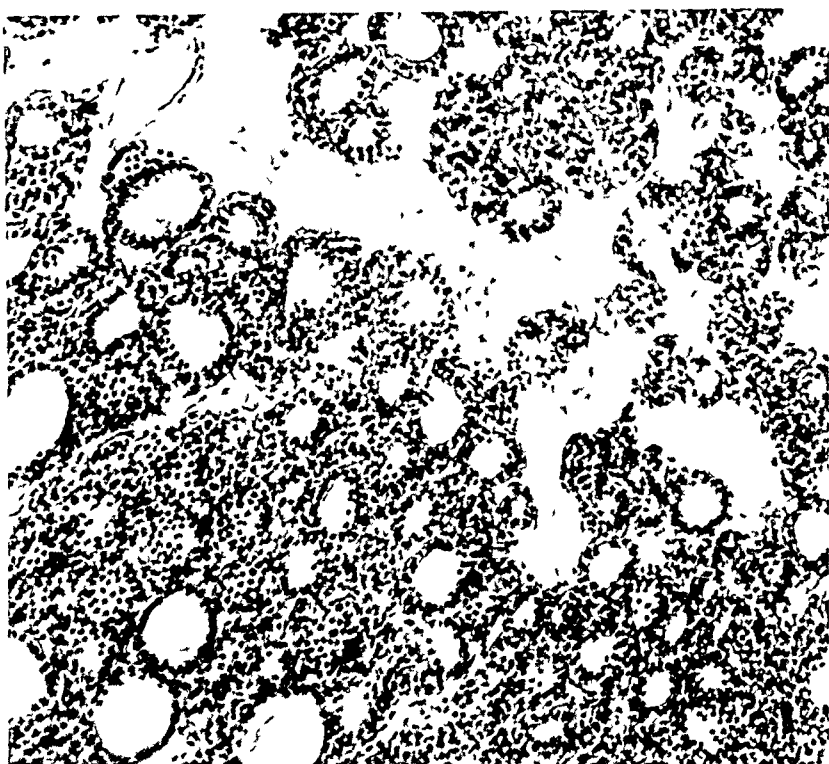


FIG 15 —From the hemorrhagic area (Fig 13-a) showing fetal adenoma ( $\times 150$ )

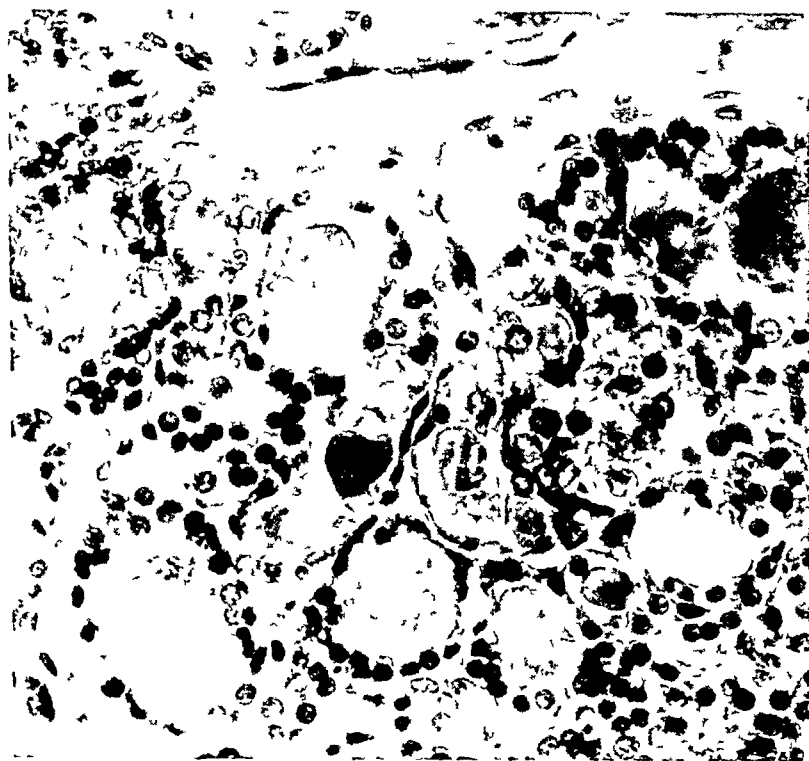


FIG 16 —From the cellular portion (b) of the benign adenoma shown in Fig 13. Histologically similar to many adenomata known to be malignant ( $\times 300$ )

Invasion of blood-vessels (Figs 9-12) also accounts for distant metastases from tumors causing no clinical symptoms or signs other than swelling in the neck. Indeed, in some instances there has been not even clinical enlargement of the thyroid, and yet the patients have died of metastases.

*Differentiation of Benign and Malignant Adenomata*—In a previous publication<sup>3</sup> the writer has set forth the conclusion that the histo-

logical appearance of cells and tissue is not a reliable basis for the

differentiation of benign and malignant adenomata ‡ At the same time it was proposed that invasion of blood-vessels be utilized as the most reliable means of making the distinction These conclusions were based on the following observations In no case in our experience in which there was what might be termed histological cancer present, recurrence of the tumor after operation, metastasis, or death of the patient as a result of the tumor, have we failed to demonstrate invasion of the blood-vessels in the original tumor, with the exception of papillary and serinous carcinomata, which together constitute

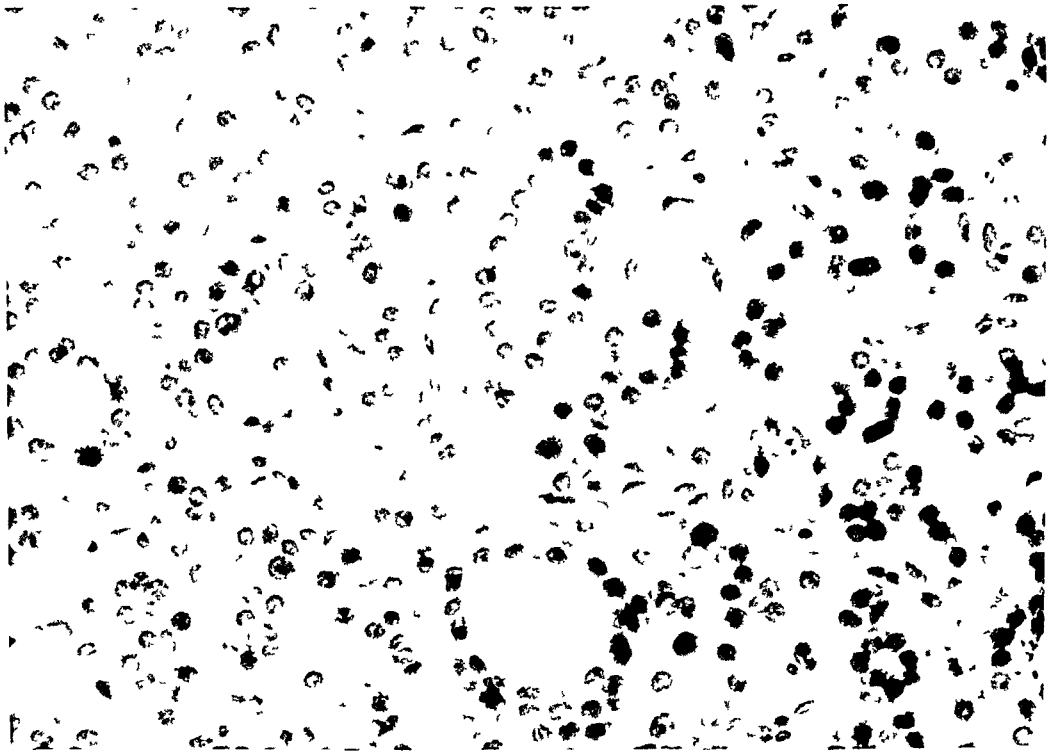


FIG 17—Photomicrograph from a benign adenoma for comparison with Fig 18 (x 300)  
See foot note below

about fifteen per cent of the total In these two types of tumors invasion of the blood-vessels has been as conspicuously absent as it has been constantly

‡ Figures 17 and 18 are practically identical histological pictures Figure 17 is from a primary benign adenoma removed from a woman aged thirty, who presented no clinical operative nor pathological evidence of malignancy This patient is in good health ten years after operation Figure 18 is from a metastasis in the clavicle of a woman aged thirty-five, whose only complaint was goitre There was no clinical or operative evidence of malignancy The primary, large, well-encapsulated adenoma was removed in 1912 Six months later the patient returned with tumor of right clavicle, which was resected She died five-and-one-half years after the primary operation from metastases in pelvis and femur, without recurrence in the neck or at the site of the resected clavicle Either picture could be used to represent the other patient's lesion, histologically, and there would be no possible way of knowing which patient would be cured and which would not, on this basis alone The original sections of the tumor of the second patient were reviewed several years later and tumor tissue was found within the blood-vessels This phenomenon was not appreciated by the writer in 1912

## MALIGNANT TUMORS OF THE THYROID

present in all other carcinomata. On the other hand, in no case of adenoma in which we have failed to demonstrate invasion of the blood-vessels has there been any clinical evidence of malignancy after operation in any of the patients traced, irrespective of the microscopic appearance of the tumor.

On the basis of the foregoing observations, 43 tumors formerly considered to be malignant adenomata, chiefly on histological grounds, have been withdrawn from the list of malignant tumors and are now classed as benign (Figs 13-16). When it is recalled that the histological appearances of many

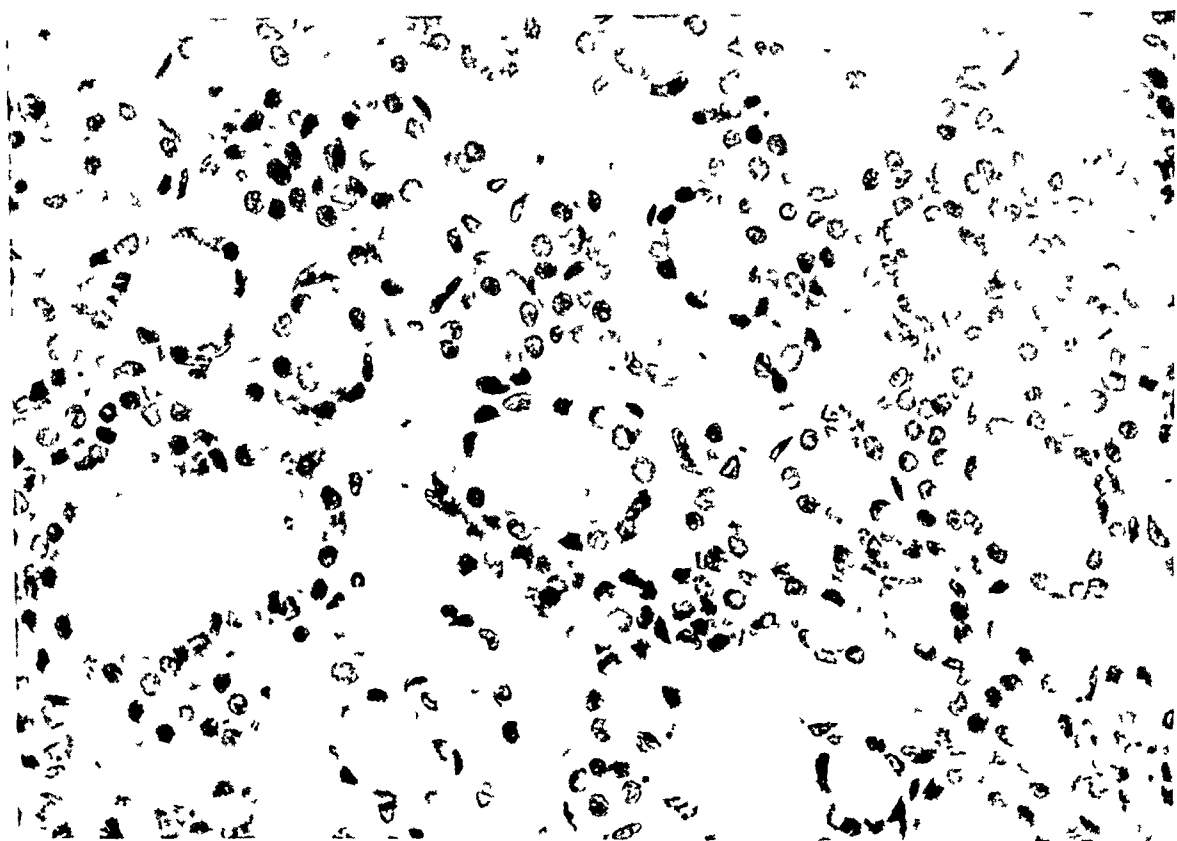


FIG 18—Photomicrograph from a metastatic tumor in clavicle for comparison with the benign adenoma Fig 17 ( $\times 300$ ). See foot-note page 42.

of these tumors, now classed as benign, can be exactly duplicated in a number of the 55 adenomata known to be malignant, and further, when it is recalled that in some of the 55 malignant adenomata malignancy cannot be reliably diagnosed on the basis of histological appearances alone, the possible importance of invasion of the blood-vessels as the determining factor in arriving at a diagnosis is apparent, and its importance in prognosis is obvious.

It is not to be supposed that this most constant single indication of thyroid epithelial malignancy will be accurate in 100 per cent of cases, since serial sections of the primary tumor are not made. Accepting a reasonable number of mistakes in pathological diagnosis, the percentage of errors will still be far less than may be expected from any other criterion that has been proposed.

We claim no originality for the observation that carcinomata of the thyroid frequently invade the blood stream and metastasize by this route. We are unaware, however, that there has been a systematic attempt made to



determine the incidence of invasion of the blood-vessels in a series of cases, to recognize types of lesions in which one may or may not expect to find invasion of the blood-vessels, nor to utilize invasion of blood-vessels as a means of differentiation of benign and malignant adenomata

The recognition of invasion of blood-vessels is not difficult. Four grades may be noted: (1) Gross thrombosis (Fig 12), (2) gross erosion (Fig 11), (3) the finding of tumor tissue or tumor cells within the lumina of blood-vessels microscopically (Fig 9), and (4) erosion of blood-vessel walls microscopically (Fig 10). Artefacts are, of course, to be excluded. Examination of the thyroid veins and the veins of the capsule of the tumor will disclose gross thrombosis and gross erosion when present. When not advanced to the degree of gross lesion a few blocks of tissue through the capsule and from any suspicious area or areas within the tumor will usually suffice for the demonstration of tumor tissue within the veins and erosion of the vein walls microscopically.

The ultimate value of invasion of blood-vessels as an indication of malignancy of thyroid epithelial tumors, and particularly its value as a means of distinguishing between benign and malignant adenoma, is a matter for the future, but on the basis of our experience to date it seems worthy of considerable confidence.

#### REFERENCES

- <sup>1</sup>Joll, C. A. Metastatic Tumors of Bone. Brit Jour Surg, 1923, vol. xi, p. 38.
- Wilson, L. B. Malignant Tumors of the Thyroid. ANNALS OF SURGERY, 1921, vol. lxxiv, p. 129.
- <sup>2</sup>Graham, A. Malignant Epithelial Tumors of the Thyroid. Surg, Gyn and Obst, 1924, vol. xxxix, p. 781.
- <sup>3</sup>Ehrhardt, O. Zur Anatomie und Klinik der Struma maligna. Beitr. z. klin. Chir., 1902, vol. xxxv, p. 343.
- <sup>4</sup>Muller, G. P. and Spencer, J. Malignant Disease of the Thyroid Gland. U of Pa. Med. Bull., 1906, vol. xix, p. 74.
- <sup>5</sup>Billroth, Th. Ueber Scirrhus Glandule thyroideae. Wien med. Woch., 1888, vol. xxxviii, p. 673.

## TUMORS OF THE MALE BREAST.

BY KELLOGG SPEED, M D

OF CHICAGO, ILL

THOUGH tumors of the male breast may seem to occur rarely, they furnish at least 1 per cent of the number of all breast tumors which afflict both sexes. A few points of peculiarity of the male breast tumors are worthy of notation on account of the infrequent discussion of these lesions. The male breast may be the site of any pathology which is ever found in the female breast, although the functional use in the two sexes is so vastly different. It might be expected that the rudimentary and non-functioning character of the male breast would lead to its rare involvement in tumor changes, but like other vestigial organs it does undergo untoward mutations and there may be valid argument advanced to prove that the breast either does or does not suffer from tumor on account of its structure.

*Predisposing Causes Including Trauma*—The predisposing causes of male breast tumors are obscure. A non-functioning gland is not subject to the hypertrophic and regressive changes incident to lactation nor to the traumata of nursing. Other traumata due mainly to occupation have an influence, as shoemaking or any similar special trade which causes repeated rubbing or pressure over the breast area during the labor. The influence of trauma cannot be definitely analyzed however. If cancer follows one trauma, the hæmatoma reaction may set up sufficient irritation to inaugurate the tumor-forming process. The effect of chronic irritation from occupation pressure or the pressure of clothing may be easier to appreciate. Certainly these irritations will lead to a rapid development of latent cancer.

As an example of chronic irritation, Rodman mentioned one man suffering from breast cancer who constantly had rested his shovel handle against his breast. (Rodman *Diseases of the Breast*, P. Blakiston's Son and Co., Phila., 1908, page 182). Examples of male breast tumor following a single trauma are rare. A man struck by a horse's bit, with a resulting bruise which slowly disappeared, had within one month a definite freely movable unattached cystic tumor following in the breast just above the right nipple. The skin over this tumor was discolored, in the centre was a bulla, but no ulceration. Griffith who reported this case (*The Lancet*, vol. 1, p. 22, January 6, 1923) described a hard nodular mass 1½ inches in diameter adherent to the skin, but not to the muscle with no axillary or cervical adenopathy. A radical operation was performed, removing the breast and underlying muscle, but not the axillary lymph-nodes. The tumor was macroscopically encapsulated and did not invade the breast tissue, nor the skin stretched over it. The cut section showed a white caseous degenerating mass which histologically proved to be endothelioma, the masses of endothelial cells

---

\* Read before the American Surgical Association, May 5, 1925

fading into hyaline degeneration with some giant cells present Murphy (*Surg Clinics of John B Murphy*, vol III, pp 569-70, 1914) operated upon a man with carcinoma of the right breast who three months before had been struck there by a bottle thrown from a distance of 10 feet The breast was immediately swollen and red, but in a week all symptoms disappeared, only to return in three weeks, when a lump developed on the outer side of the nipple At operation a tumor the size of a pigeon's egg was removed It was

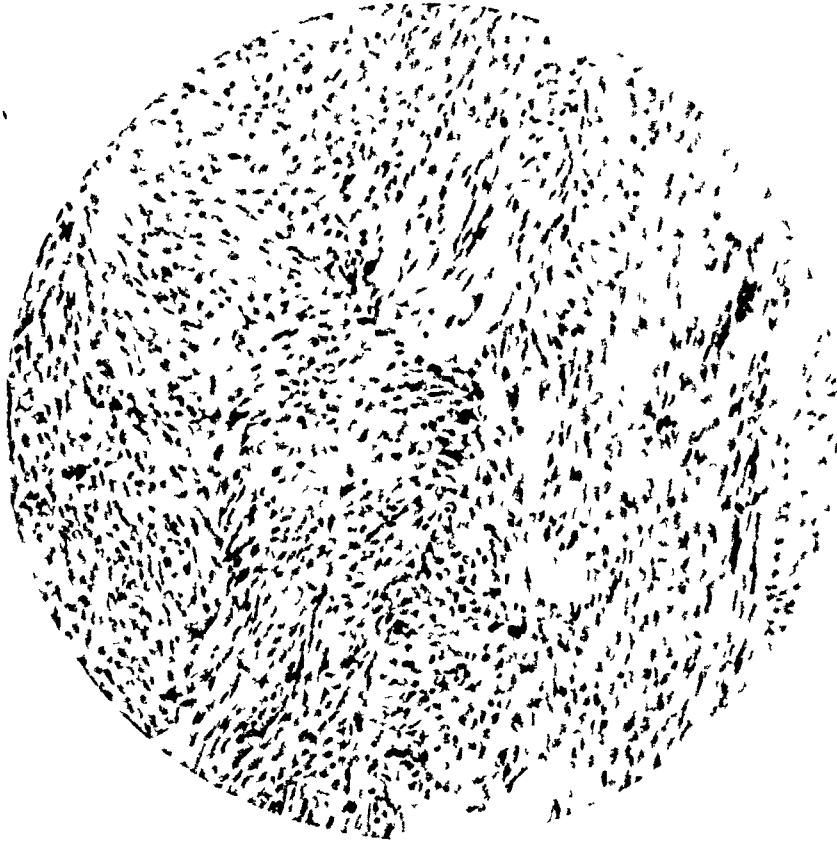


FIG. 1.—Photomicrograph of the breast fibro sarcoma of patient No. 1. The irregular array of the spindle cells and the lack of stroma are clearly distinguished

not fixed to the other tissues nor accompanied by nipple retraction, skin pitting or enlargement of the axillary lymph-nodes Manger in 71 collected cases in men found a preceding trauma in 25, Yamamoto in 257 cases found traumatic history in 61—over 23 per cent Ten per cent of his patients gave an hereditary cancer history

*Age*—The age at which male breast tumors are found has wide variation Lunn reports (*Trans Path Soc of London*, vol XLVIII) mammary cancer in a man aged ninety-one years Simmons (*J A M A*, vol LXVIII, p 1899, June 12, 1917) had as patient a boy aged thirteen years, 121 pounds in weight, who was struck on the right breast by a baseball bat a year before being examined He noticed burning and stinging in that breast followed in a few months by swelling and tenderness The only family history of carcinoma was in an aunt aged thirty-five, who had an adenocarcinoma of the uterus The entire breast and surrounding fatty tissues were removed No axillary involvement was found, but a microscopic diagnosis of a medullary adenocarcinoma was made Bryan reported a similar case in a boy of fourteen years eight months, and Thompson (*Brit Med Jour*, 1908, vol II,

## TUMORS OF THE MALE BREAST

p 502) one in a boy of fifteen years In 1897, Blodgett (*Boston M and S J*, vol cxxxvi, p 611, June 17, 1897) reported a breast tumor in a boy of twelve This was situated below the left nipple, attached to it, and with an appreciable swelling The nipple was slightly reddened and harder than the opposite nipple

The tumor increased in size in a few months It was removed and the histological section showed carcinoma invading all the glandular tissue of the breast There was no recurrence up to five years afterwards Moore and Coley and Benet (*J S Carolina M A*, vol xvi, p 245, Oct, 1920) record carcinoma in boys aged twelve and nineteen years, respectively Sir D'Aicy Power found in the breast of a three-year-old boy a multilocular cyst which grew to the size of an orange

Schneller  
(*Archiv fur*

*Khin Chin*, vol cxix, p 169) says that the average age of women afflicted with breast cancer is, according to Winwater forty-five and three-tenths years according to Guleke forty-nine and two-tenths years, whereas Yamamoto found the average age of men thus afflicted was fifty-four years, and that the occurrence found in his collection of German statistics was 11,654 female and 167 male cancers

*Relative Occurrence—Statistics*—The occurrence of cancer in the male

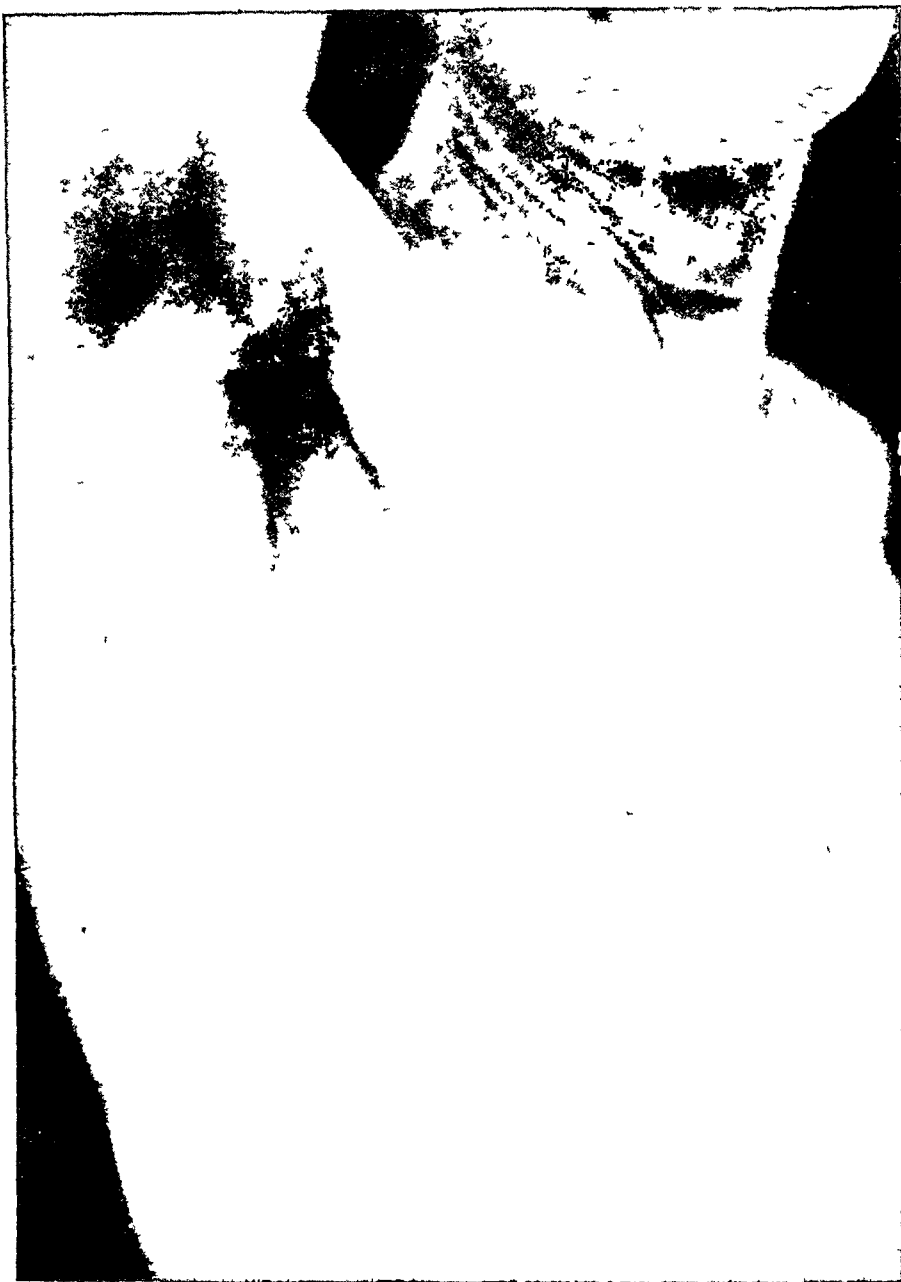


FIG 2—Photograph of the involved breast and axillary region of patient No 2 Beneath the nipple is seen the slightly bulging elongated carcinoma spreading upward into the areola Scattered on the skin surface both anterior and posterior to the lateral border of the sterno-cleido-mastoid muscle can be seen secondary cancer nodules The axillary enlargement is not visible

breast is about the same in all statistical resumes, namely from 1 to 2 per cent of all breast tumors. Maimaduke Sheild (*Diseases of the Breast*, 1898, p 286) found nine cases in males in 628 of carcinoma of the breast. Muller (*Arch f. Klin. Chir.*, vol cxx, p 686, 1922) found in twenty-one years

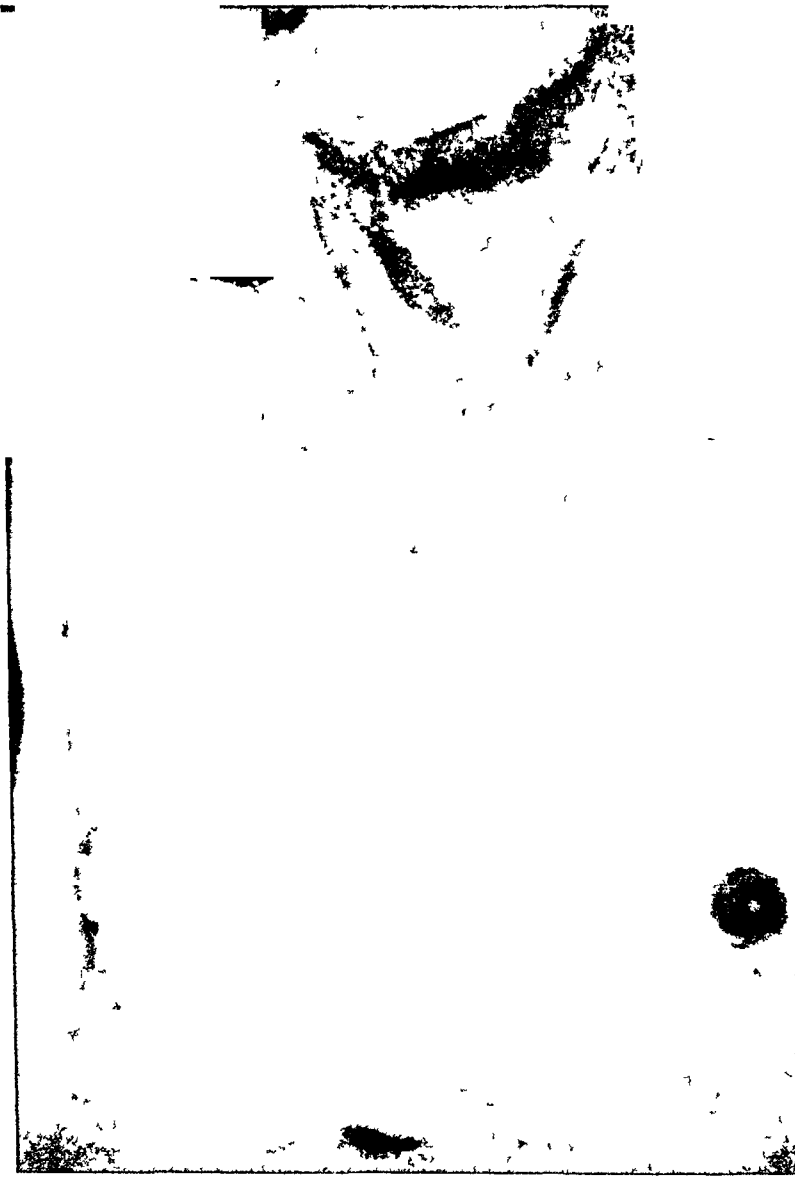


FIG 3 —The size and extent of the tumor mass of this breast carcinoma can be seen around the right nipple. The secondary tumors in the skin above the breast are evident.

in von Eisberg's clinic that there were 600 cases of carcinoma of female breast and twelve in male breast, all patients being over forty years, except one who was twenty-eight. The influence of trauma seems high. Williams found in 2,122 primary neoplasms of the breast twenty-five were in males, of which there were sixteen carcinomata, two sarcomata and six benign tumors. Fessler (*Deut. Ztsch. f. Chir.*, vol clxxii, pp 429-37, 1922) found 700 cases of male breast carcinoma in the literature up to 1919. He thinks most cases arise after 57 years of age.

**Breast Occurrence** —The right breast seems to be involved with slightly greater frequency. Cumston (*Internat. Clinics*, 1920, vol 11, p 25) reviewed a total of 266 male carcinomata and found that the right breast was involved in thirteen instances more than the left. Other collections and reviews of the subject are given by Finsterer (*Deut. Ztsch. f. Chir.*, vol lxxiv, p 202, 1906), Schuchardt (*Arch. f. Klin. Chir.*, vol xxvi, p 249) and Schneller (*Arch. f. Klin. Chir.*, vol cxix, p 169).

## TUMORS OF THE MALE BREAST

*Pathology* —Sarcoma —Sarcoma is a frequently found malignant tumor of the male breast. It tends to penetrate the underlying fascia and muscle and to ulcerate through the skin early. The tumor does not grow to great size before metastases lead to a termination.

Carcinoma —Carcinoma is the slowest growing of the malignant neoplasms, usually a small indolent tumor, painless and often unnoticed at the start. It is quite indefinite in its outline, seeming to merge with the tissues about the nipple and breast proper when it is superficial. It invades these structures by

extension. Deeper lying cancer early has a hard kernel-like feel—at first freely movable like a small nut, but later fixed, extending into the small amount of breast tissue. In about half the cases the nipple becomes involved. The nipple may be destroyed or may discharge bloody serum. The discharge is only rarely milky. The

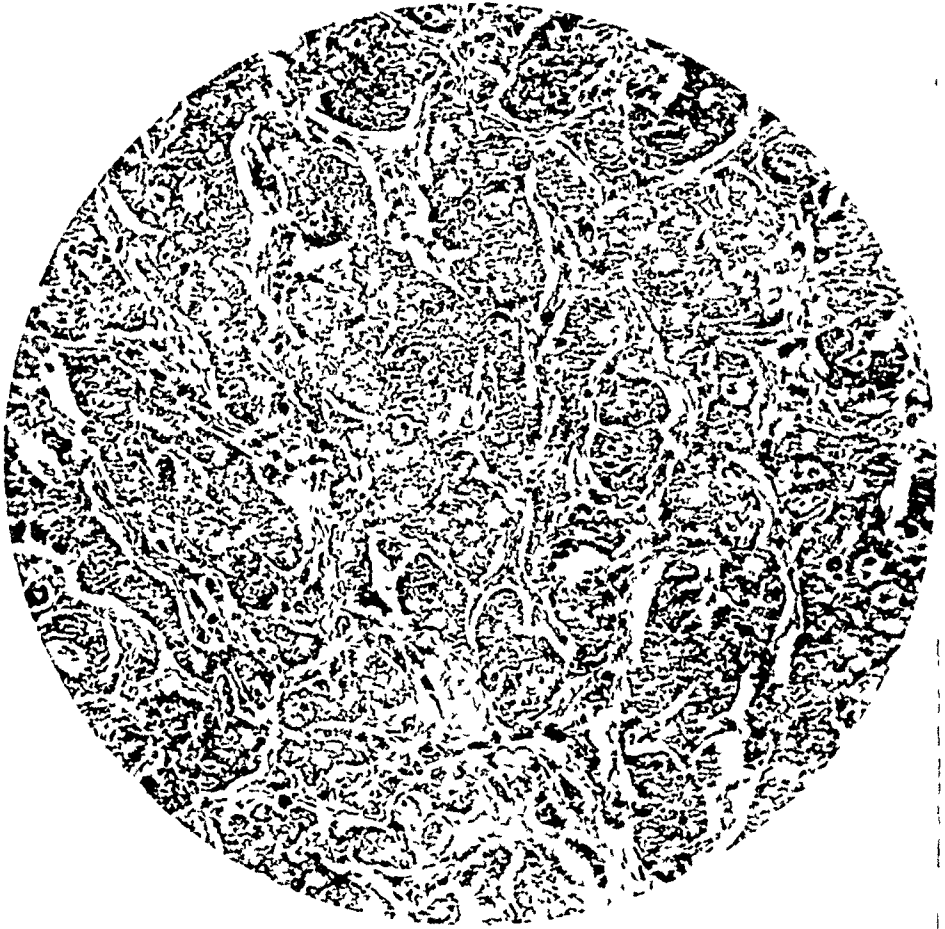


FIG. 4.—The section taken from the main cancer mass of patient No. 2. This is plainly malignant.

skin early becomes infiltrated and ulcerates. Retraction of the nipple is not often seen, probably on account of the small size of the male breast and the lack of the connective-tissue bands in the suspensory ligaments. The tumor metastasizes into the skin, muscle, fascia and axillary or other lymph-nodes.

Melanoma —Melanotic male breast cancers occur. I find eighteen cases recorded in the literature (Foigue and Chauvin, *Rev. de Chin.*, vol. lvi, p. 1, January, February, 1919). One existed in a boy aged ten years and all presented rapidly fatal metastases after seeming frequently to take origin in warts or naevi.

Other Tumors —Angioma, lipoma and chronic mastitis are recorded in the literature, but sarcoma and carcinoma are by far the leaders numerically.

in the recorded tumors Galactocela, one instance of which I record here—seems to be rare I find no mention of it, although cystic adenoma, to which it may be compared, is known A large subpectoral lipoma of the mammary region in a man seventy-three years old was reported by Toriaca (*La Riforma Medica*, vol xxxviii p 1157, Dec 4, 1922)

*Direct Extension of Cancer*—The thinness of the pectoral fascia in the male demonstrated by Heidenham (*ANNALS OF SURGERY* 1889, vol x, p 383) accounts for the close attachment of the breast tissue to the covering of the

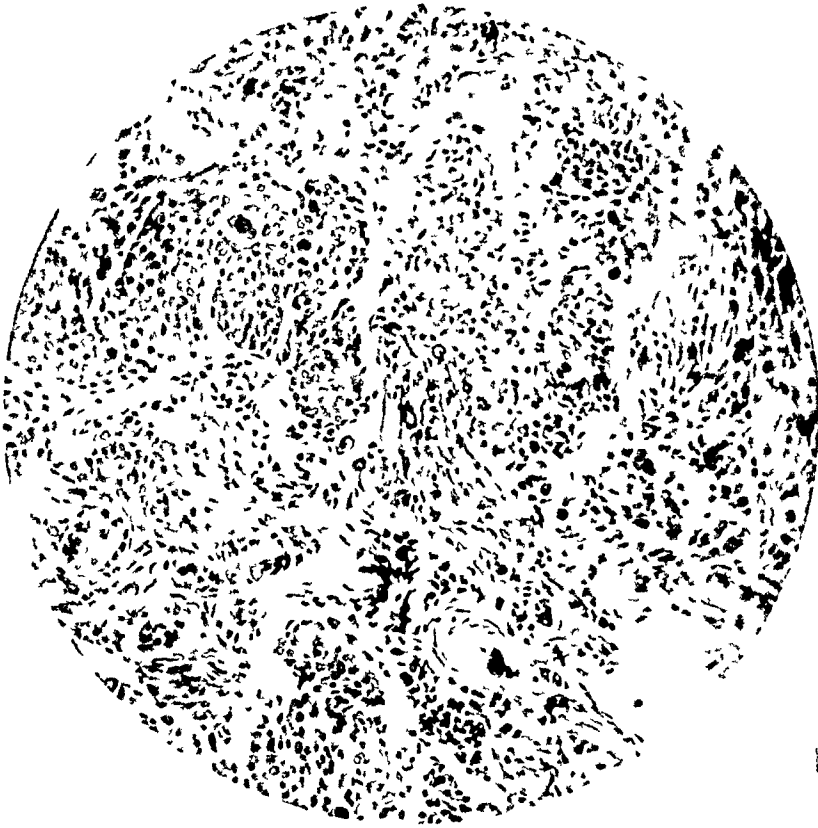


FIG 5—A higher magnification of the breast cancer shown in Fig 4 The invasion of the cancer cells and a few remnants of alveolar structures are discernible

pectoral muscle A malignant tumor easily breaks through this fascia and invades the muscle *via* the lymphatics which run from the breast to and along the fascia A breast cancer may consequently appear to be freely movable on the underlying muscle and yet be invading it along these microscopic lymphatics Superficial removal cannot be expected to give radical cure This particular point is referred to emphatically by Speese (*Penn Atlantic M J*, vol xix, p 488) Cancerous emboli may also be found in the connective-tissue strands radiating from the primary tumor into the surrounding breast tissue and fascia Stiles (*Trans Med Clin Soc Edin*, 1891, vol xi, p 37) Muscle use and contraction after its invasion by cancer must lead to rapid dissemination *via* the lymphatics and by direct extension The muscle bundles are invaded and destroyed, yet the process may be entirely microscopic (See Fig 6) A study of the degree and frequency of muscle involvement was made by Speese in 100 carcinomatous breasts removed with the muscle attached Twenty-five specimens presented muscle involvement

## TUMORS OF THE MALE BREAST

showing (a) carcinoma cells in contact with muscle on the fascial surface, (b) carcinoma in the lymphatics or spaces between the muscle bundles, (c) muscle tissue destroyed and replaced by carcinomatous invasion. In thirty-five out of the 100 specimens the pectoral fascia was invaded by the cancer and in five where the tumor was not in contact with the fascia there were found nevertheless metastases in the muscle from 1 to 4 cm distant from the fascial surface. In the male these extensions to muscle must be very frequent on account of the small amount of breast tissue and its immediate proximity to the pectoral fascia.

### Metastases

—The metastases to the skin and to the muscles are especially noteworthy. Multiple small lobules may be found stretching out in a line from the nipple toward the axilla in the skin. The muscle metastases in the early stages are not apparent, they may be microscopic for a long time. Later they lead to pain on exertion and fixation of the tissues on the front of the thorax.

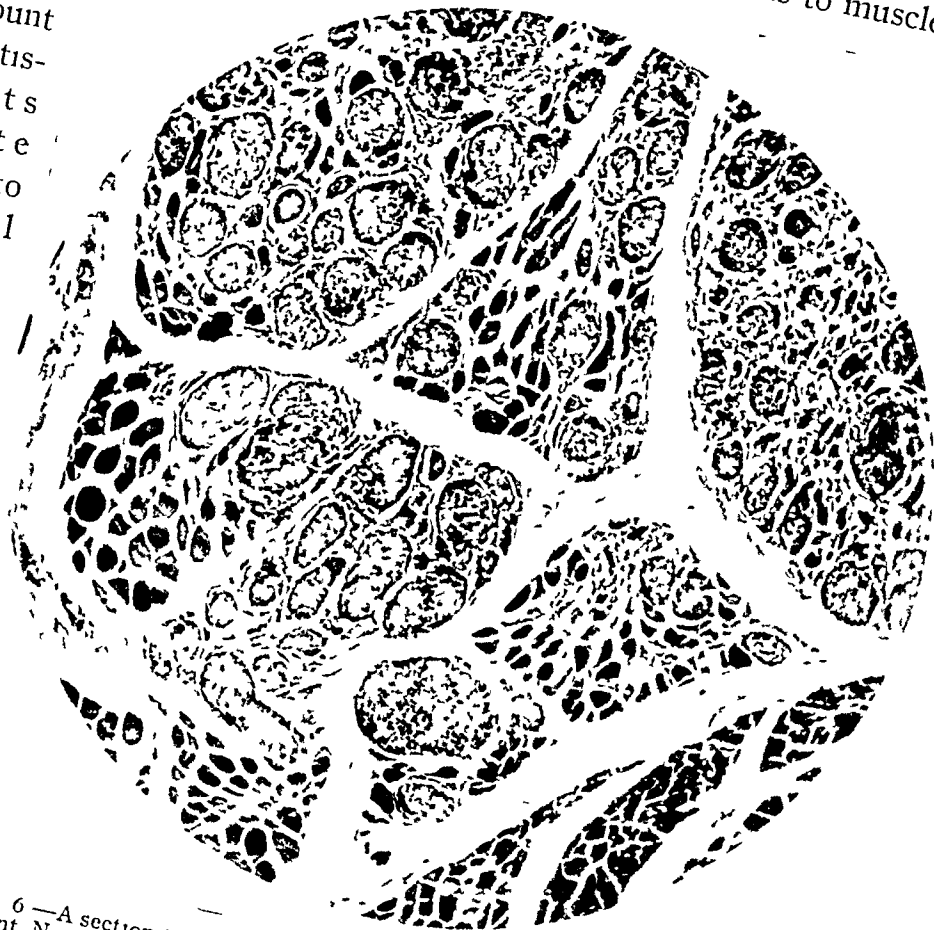


FIG 6 —A section taken from a cancerous nodule in the pectoralis major muscle of patient No. 2. The septa between muscle bundles, the cancerous invasion of groups of bundles and the process of displacement of individual bundles can be seen. This is muscle metastasis in cancer of the male breast.

Skin metastases are seen in women but are considered as unusual. Newcomb (*Lancet*, vol 1, p 1056, May 24, 1924) reported a hard tumor of the left breast in a woman on whose skin there were multiple dark nodules 0.3 to 4 cm in diameter. These were found scattered over the whole chest, raised above the skin level and near the right breast were several wart-like pigmented tumors. A diagnosis of melanotic sarcoma was made. The post-mortem examination showed that the color of the nodules was caused by blood not pigment. There was a papillomatous overgrowth of squamous



skin epithelium lying on a core of secondary carcinoma columns projecting up through the dermis. In some areas carcinoma cysts were present and the cross-cut section revealed that the carcinoma had grown up along the lymphatics to the surface of the skin and then had mushroomed out, forming cavernous blood spaces beneath the surface. Newcomb considered this point remarkable in so far as the squamous epithelium had proliferated over the cancer instead of ulcerating.

*Lymph-nodes and Other Metastases*—The axillary lymph-nodes in men

— appear to be involved late in breast cancer. Statistics show about 60 per cent invaded at time of operation or autopsy. The detection of their invasion is not difficult as the male axilla is devoid of much fat. The nodes appear discrete and very hard in the average case. In addition to regional metastases we may find a distribution of secondaries in any

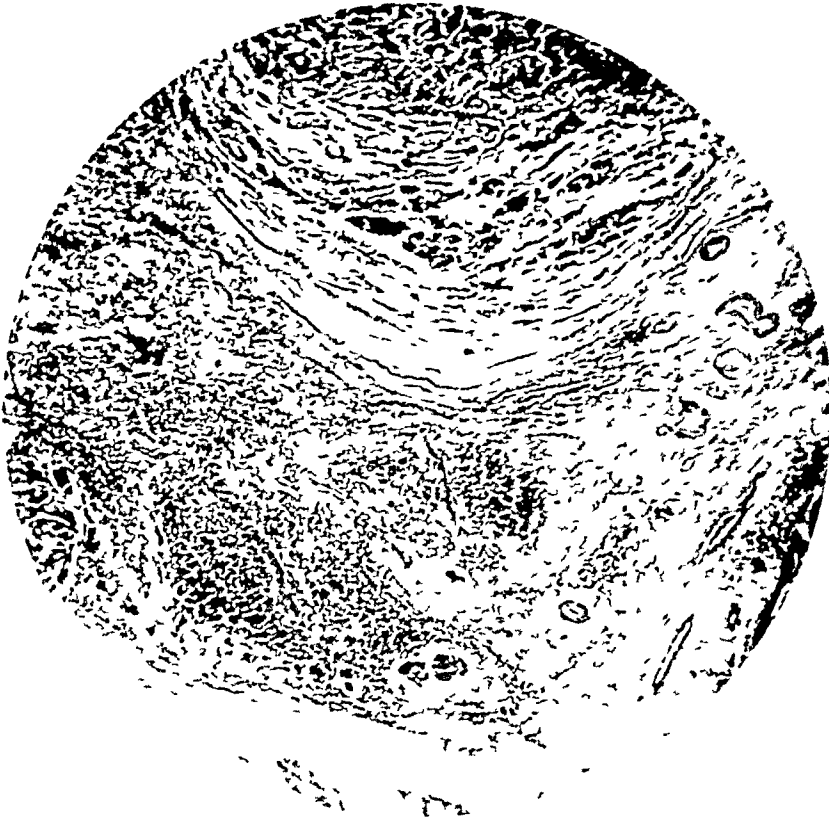


FIG 7—A section of an axillary lymph node removed from patient No. 2. This shows islands of cancerous cells present in the main mass of lymphatic tissue—lymph node involvement in male breast carcinoma.

part of the body—especially the liver, lungs and bones. Of 88 cases recorded by Williams, 5 had bone metastases involving both clavicles, tibia, vertebra and skull.

*Types of Cancer*—Poirier says (*Progres Med*, Paris, 1883) that the breast in the male is the site of various kinds of cancers. The most common is scirrhus carcinoma, usually of comparatively inactive type. Such tumors show the same features in the male as in the female with the difference that on the whole these are all less marked. The chances of radical cure varying according to the anatomical features of the tumor appear to be greater in the male than in the female. The types Poirier described were

- (1) Typical scirrhus, commonest
- (2) Pustular and disseminated scirr-

## TUMORS OF THE MALE BREAST

thus (3) Cancer *en cuirasse* without ulceration (4) Epithelial carcinoma with metastases in neighboring lymphatics (5) Encephaloid or medullary carcinoma (6) Melanotic carcinoma (7) Cystic carcinoma (8) Carcinoma with metastases in bone

*Rate of Growth* *Ulceration*—On the whole, male breast carcinoma is of slow growth and may commonly exist for as long as three years and sometimes seven to eight years before it really causes symptoms which lead to diagnosis. Skin

ulceration appears to come on very late—after four or five years—and the tumor then may take on the aspect of an infected fungoid growth much like the same type in the female. A high percentage of tumors in the male ulcerate, possibly on account of the small amount of breast tissue and its relative superficial position. The rate

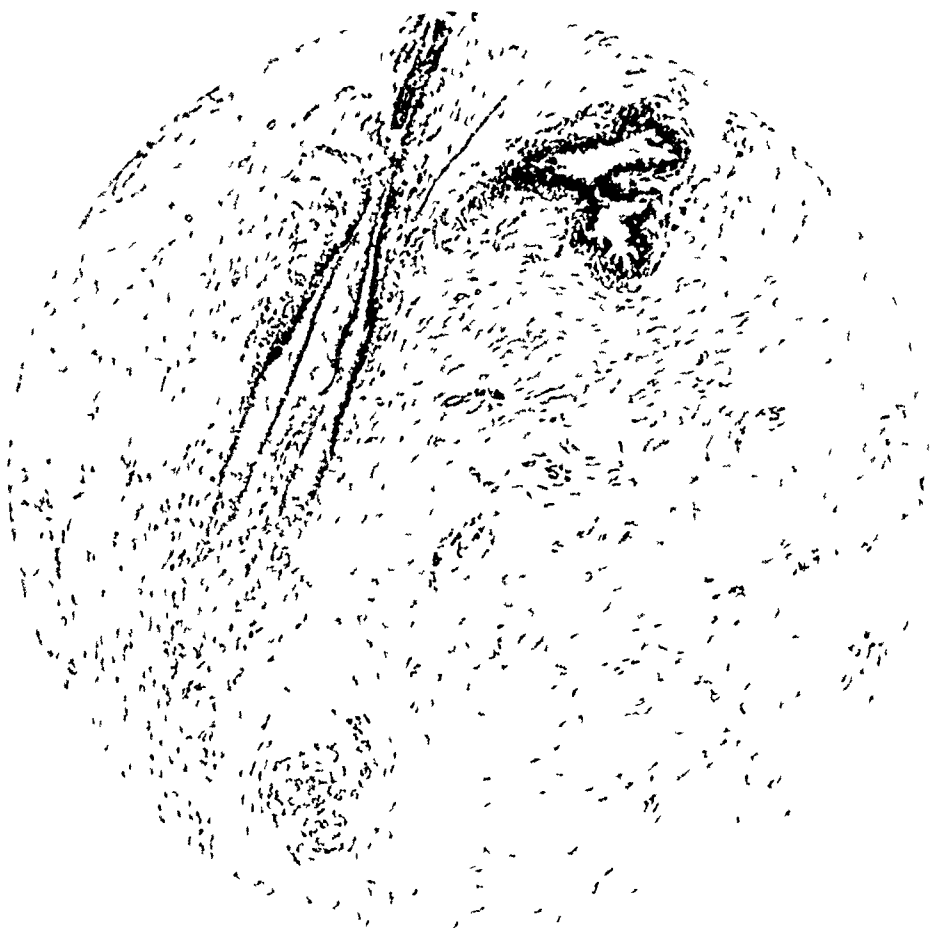


FIG. 8.—Section through the fibro-adenoma of the male breast of patient No. 3. The typical adenomatous male breast of patient No. 3. The adenomatous arrangement with a rich fibrous stroma and the lack of malignant features are noticeable.

of growth of the different cell types also is comparable to the analogous form in the female—the melanotic type being extremely malignant and causing early metastases, the adenocarcinoma being quite malignant and the epithelial-celled tumor probably the least malignant of all. The primary tumor in the male breast may be so small or have caused so few symptoms that it is overlooked and the secondary growth attracts attention as a primary tumor.

*Recurrence of Cancer*—Post-operative recurrences are less common in men than women and the tendency to a late recurrence after several years does not seem to exist—most recurrences arising locally soon after operation, possibly because the extent of the minute local metastases in muscle and lymph-nodes is not recognized and a single local excision of the breast tumor is done.

RISCHBITH (*The Med Journal of Australia*, vol 11, p 205, September 9, 1916) reported in adenocarcinoma with metastatic deposits in a man aged thirty-three years. Two years before he was seen he had noticed a tumor in his left breast. In a year it was removed but within ten months following recurrence set in. There was no pain, no nipple discharge and a scar an inch long existed over the left nipple. Beneath this was a small hard almond-sized mass and two other small tumors in the breast external to the nipple. The skin was not adherent and all three tumors moved over the deeper tissues. There were half a dozen enlarged hard axillary lymph-nodes. At operation he left behind most of the pectoral muscle and the patient returned in five and one-half months with four small areas of recurrence in the operative scar.

One other case VIRCOS (*Idelaide Medical Students Society Review* June, 1916,

p 63) developed evidence of metastases in the cervical spine three weeks after operation for cancer of the male breast. There are too few published reports of radical operation in men on which to base the relative frequency of recurrence after complete surgical removal. LOCKWOOD (*Oxford Medical Publications* London, 1913 p 63) recorded an operation in a man fifty-six years of age for breast cancer. He did not perform a complete radical operation as we understand the term to-day but he did take out the axillary lymph-nodes and the pectoral fascia. Three times in the following year small recurrent nodules in the skin were removed. The patient was alive four years after his

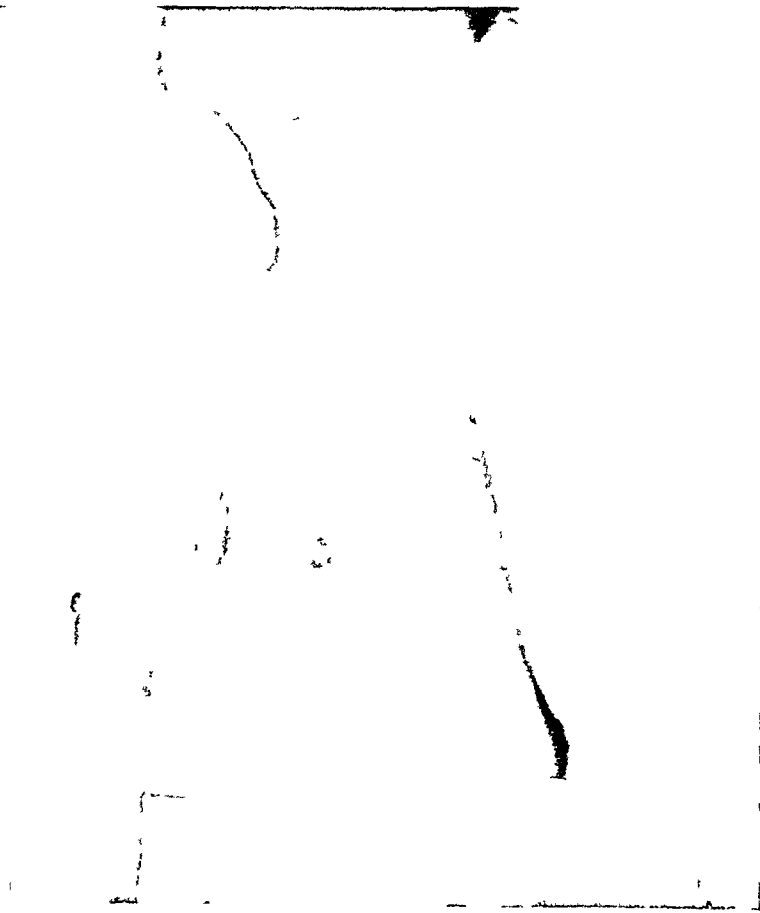


FIG 9—Photograph of patient No. 4 showing the tense cystic tumor of the right breast. This was of only three months' duration according to the patient and when removed proved to be a benign galactocoele.

operation and free from further growths. Speese gives an average life of fifty-one months after operation on women.

**Symptoms**—Amongst other common symptoms of breast tumor we may say that pain is frequently entirely lacking. A sizable tumor is often wanting and the constitutional symptoms of weakness, loss of weight and anæmia develop very late. Ulceration may be very early as we have seen, but metastases are long delayed in most forms except the melanotic and round-cell sarcoma.

## TUMORS OF THE MALE BREAST

*Treatment*—The treatment of all male breast tumors should naturally rest on the diagnosis. Chronic mastitis and the benign tumors may not require early radical removal, but from our experience with the female breast tumors we can well afford to err on the safe side and do radical removal of the pathologic male breast, innocent as it may seem even to the microscope. Complete removal of pectoral fascia and muscles with block dissection of the axillary, sub- and supra-clavicular lymph-nodes is indicated where there is ulceration or the slightest suspicion of malignancy. When secondary skin nodules are found they and their surrounding skin must be removed.

*Operative Difficulties*—In the male radical breast operation frequently will lead to inability to close the wound, because the chest tissues are not so lax, nor is there as much subcutaneous fat as in the female. The skin metastases demanding a great sacrifice of skin will add to this difficulty. Radical removal must be performed in spite of this.

*Differential Diagnosis*—Differential diagnosis of the male breast tumors must include a wide range of possibilities such as hydatid cyst, tuberculous abscess of the ribs or breast itself, non-ulcerating gumma, fibroma adenoma, lipoma, mastitis of puberty, galactocele, chronic mastitis, gynecomastia and the various malignant new growths.

### SUMMARY

The writer's review of this subject confirms these outstanding points

- (1) The relative occurrence of tumors of the male breast is between 1 and 2 per cent of all breast tumors
- (2) All different types of tumors—benign and malignant—may be met
- (3) There is usually delayed recognition of cancer of the male breast
- (4) Male breast cancer progresses slowly
- (5) Trauma, especially occupational trauma, seems to be an important etiological factor in male breast carcinoma
- (6) Direct involvement of fascia and muscle by microscopic lymphatic extension is very common in male breast cancer
- (7) A radical operation for removal of malignant breast tumors is just as necessary in the male as in the female and a surgeon should not be fooled by the relative size and non-fixation of the tumor mass—the secondaries are microscopic
- (8) The male offers probably a better prognosis and a longer life expectancy after radical removal of breast cancer than does the female

### PERSONAL CASE REPORTS

The following patients have been operated upon for breast tumors

CASE I—Thos M., white male, fifty-eight years old single laborer, entered the hospital August 13 1923 complaining of a mass on the left breast which was reddened not painful, but was enlarging. Four months before he had noticed a "blackhead" at this point which had been squeezed. A red nodule appeared which gradually enlarged. After two months a small amount of purulent material was discharged, since then a slight discharge has continued. The tumor has become dark reddish-purple in color.

## KELLOGG SPEED

His past history furnished no information relative to this tumor and his recent occupation, that of rag sorter, had caused no irritation of his breast. His appearance was that of a healthy, well-developed man. The only abnormal findings were on the left breast, where a fungating irregular dark red pedunculated mass 5 cm in diameter was found 8 cm below the areolar point. The surface was covered in several areas by a foul-smelling yellow exudate. There was no axillary adenopathy composed of firm rounded and movable pea-sized masses. The blood Wassermann was negative.

His blood findings were 90 per cent hemoglobin, 11,400 white blood-cells. Blood-pressure 115—88 mm.

On August 20, 1923, a radical breast operation was performed, the excision going wide of the ulcerating area.

### *Pathology—*

The gross specimen was a firm tumor mass located as already described. When the tumor was cut across the surface was moist and the deeper portions were brown.

FIG. 10.—A closer view of the galactocele of patient No. 1. The cystic tumor lifted the whole breast including the nipple—forward.

while the superficial portion was whitish. The pea-sized axillary glands were also of the same color and were hard. A frozen section stained with hematoxylin and eosin revealed spindle cells in an irregular array.

In paraffin stained section of this block of skin and subcutaneous there was seen a marked invasion of the tissues with spindle cells reaching to and in one place penetrating the covering epidermis. The new growth consisted of closely packed spindle-shaped cells irregularly arranged with acidophile opaque cytoplasm and vesicular hyperchromatic nuclei. The intercellular stroma was not visible. There was wide variation in size, shape and chromatin content of these fusiform cells while mitotic figures were frequent. At the point of ulceration and in the immediate neighborhood were collections of polymorphonuclear leucocytes. (See Fig. 1.) Diagnosis: Fibrosarcoma of the subcutaneous tissues with ulceration of the overlying skin.

The wound healed with some secondary infection. There has been no recurrence to date, twenty months after operation.

CASE II—Michael C., white male, sixty years old married, hotel houseman, entered the hospital, September 3, 1924, complaining of a lump in the right breast. This lump was first noticed a month before when he experienced a burning sensation near the nipple and found a tumor just below the nipple with several smaller lumps in the adjacent skin along the upper outer border of the breast. (See Figs. 2 and 3.)

## TUMORS OF THE MALE BREAST

*History*—He had lost forty pounds in weight during the last three years and his appetite had been poor. There had been no cough, no bleeding from the nipple, but a doubling in size of the tumor in the last month. His family history contained the information that one daughter had cancer of the breast, one died of tuberculosis, six others were living and well. His general physical examination was of no help as far as any bearing on the present complaint was concerned. The breast tumor was hard, about 3 cm wide, deep brown, lying just below the right nipple. It seemed to be frozen to the skin and underlying tissues and there were several smaller similar nodules in the skin extending toward the axilla. In the axilla under the edge of the pectoralis major there was a hard mass of lymph-nodes 2 cm in diameter composed of nodules which were partly round and discrete, partly fused together. The skin nodules were hard, raised above the surface and not umbilicated. No supraclavicular lymph-nodes could be palpated.

The nipple was not retracted and the mass of the breast tissues did not appear to be fixed to the chest wall. The left breast was negative. His liver seemed hard and its edge was palpated about three fingers' breadth below the costal margin. No nodules could be felt on its surface. An X-ray of the chest was negative as far as any cancer metastases were



FIG. 11—Another view of the galactocoele of patient No. 4

concerned. There was a diffuse infiltration of the left apex with a few lines in the right ascending bronchial tree. The hilus markings were as a whole quite prominent.

*Operation*—On September 9, 1924, a radical excision of the breast with both pectoral muscles and axillary contents was performed. On account of the amount of skin which had to be removed some of the healing was by secondary intention. In April, 1925, it is completely healed and there is no evidence of any secondary growth.

*Pathology*—The gross specimen consisted of an amputated male breast with the underlying subcutaneous tissues and muscles. There was a firm nodule just beneath the nipple, about the size of a walnut, which was adherent to the skin and surrounding tissues. On cut section it was white with silvery striae running through it. In addition, within the skin itself there were numbers of hard bean-sized nodules scattered diffusely over the breast, which on section resembled the larger tumor mass. The attached lymph-glands showed infiltration with similar tissue. The pectoralis major muscle contained one tumor nodule about the size of a lima bean. This was definitely within the muscle tissue, invading the bundles.

*Diagnosis*—Carcinoma of the breast with metastases to the pectoralis major, axillary lymph-glands and the skin.

*Microscopic Description*—In sections taken from this specimen there are seen in the main mass just below the nipple areas of irregular dark-staining epithelial cells

between which a small amount of fibrous stroma is present. The nuclei reveal mitotic figures. A few alveoli are present in the centre of some of these masses (Figs 4 and 5). Sections taken from the pectoralis major reveal carcinomatous masses replacing many of the muscle bundles (Fig 6). Tissue from an intracutaneous nodule and from an axillary lymph-gland reveal carcinomatous metastases (Fig 7).

CASE III—William P., white male, forty-six years old married, plumber, entered the hospital on the medical service, December 17, 1924, complaining of shortness of breath, swelling of the ankles and scrotum and tumor of the right breast. He was in a state of failing cardiac compensation, the second attack he had experienced. His heart

was brought into proper condition by medical treatment with rest, following which he was transferred to the surgical service for operation. His complaint was of a right breast tumor which had existed three months. Its appearance was preceded by dull pain in the breast of about six weeks' duration. This pain was inconstant and the breast had been rubbed with a liniment. No discharge had ever occurred from the nipple. The tumor was above the nipple, hard, size of a hen's egg, slightly irregular and

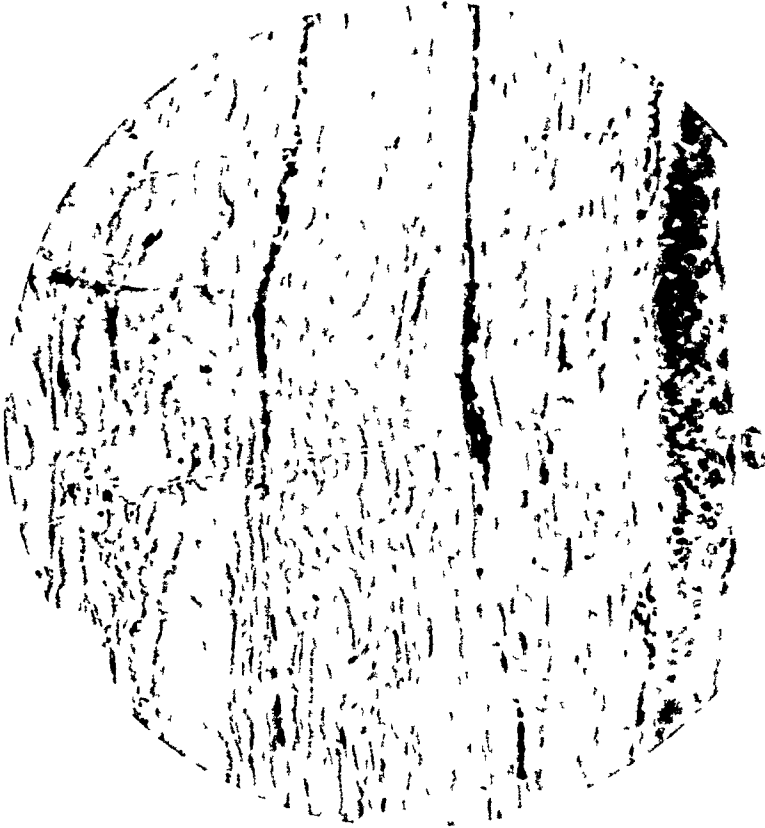


FIG 12—Microscopic section of the galactocoele wall. Its dense fibrous structures is seen. On the right hand edge is seen the skin surface. On the left hand edge the secreting layer of cells has been lost. Buried in the fibrous wall are seen the larger dark staining nuclei of compressed secreting elements.

painful to manipulation. The skin over it was not fixed and contained nodulated veins and the tumor was freely movable on the chest tissues. The blood Wassermann was negative. An X-ray of the chest showed only an enlarged heart and pulmonary congestion. The axilla contained no enlarged lymph-nodes, but in the inner triangle of the neck between the sterno-cleido-mastoid muscle and the clavicle there was one enlarged node the size of a pigeon's egg with a smaller one below it. These were also slightly painful.

*Operation*—On account of the patient's general condition an operation under local anesthesia with 1 per cent novocaine and adrenalin solution was thought to be wise. The breast was removed on January 19, 1924, down to the pectoral muscle. Through a separate incision above the clavicle the enlarged nodes there were also taken out.

*Pathology*—The description of the gross breast specimen was a moderately soft apricot-sized homogenous tumor mass, outlines well defined, situated around the nipple

## TUMORS OF THE MALE BREAST

area The nipple and skin over the tumor were freely movable and not puckered A cut section showed a fatty homogenous mass The supraclavicular lymph-node was nut-sized and when cut was caseous in its centre In sections taken from this breast tumor there was seen scattered among the fat and fibrous elements a few epithelial structures The latter were in places arranged in elongated forms resembling tubules lined by a single layer of columnar epithelium Elsewhere they appeared to be cut in cross-section There was a marked increase in fibrous tissue about these glandular elements (Fig 8) Diagnosis Fibro-adenoma of the breast

In microscopic sections of the supraclavicular lymph-gland there is seen a central



FIG 13—Primary ulcerating carcinoma of breast in man aged forty-nine years This had a duration of about four years, apparently the disease started in or near the nipple which at this time was completely ulcerated away and the process extended into the pectoral muscle There were no secondary masses in the skin There was an axillary adenopathy On account of the nipple involvement this might be classed as a Paget's disease of the male breast

caseous mass surrounded by a granulation tissue capsule rich in epithelioid and round cells with an occasional giant cell There was no evidence anywhere of neoplastic growth Diagnosis Chronic tuberculous lymphadenitis

CASE IV—William M, white male, fifty-three years old, married, laborer, entered the hospital, January 9, 1925 with the history of a rapidly growing tumor three months old on his right breast, with pain and distention of the right groin and scrotum He had a right inguinal hernia and hydrocele, which had enlarged rapidly in the last year His general history was of no interest in regard to the breast tumor He was a well-nourished white man and our main interest centred on the right breast

In and around this right nipple there was a rounded mass the size of an orange (See Figs 9 10 and 11) This was quite uniform cystic-like and yet firm, not unlike an adolescent female breast (See photograph) We feared that he might have a unilateral gynecomastia, but on repeated questioning he affirmed that the tumor had



been growing only three months since he first noticed it. There were no nodules in the breast and the axilla was normal.

Because of the rapid growth of this tumor we advised radical removal of the breast. This was done a week after admission, both pectorals and axillary contents were removed with the intact tumor attached. The gross specimen consisted of a male breast with the attached pectoral muscles. Below the nipple was a spherical cystic swelling, diameter about 7 cm. The overlying skin was freely movable. On opening into this swelling 145 cc of a thin milky fluid with a finely flocculent precipitate escaped. After standing in the ice box twenty-four hours this fluid was found curdled like milk. The wall of the cyst was thin, white and slightly granular. No tumor nodules were noted

anywhere in the muscles. Diagnosis: Solitary cyst of the male breast. Galactocoele?

A microscopic section of the cyst wall (see Fig 12) shows laminated fibrous tissue in closely packed layers. On account of the pressure within the cyst the skin covering was seen to be reduced to almost a straight layer of epithelial cells arranged in typical order from columnar at the base to pavement epithelium on the surface, without any dipping be-



FIG 14—Photomicrograph of the primary scirrhus carcinoma of the male breast. The large amount of fibrous tissue is evident in this section taken just beyond the ulcerating edge. There is considerable leucocytic infiltration.

tween papillæ. The same pressure may account for the absence of the secreting lining of the cyst inasmuch as the block for section was not prepared at once and the cells probably disintegrated and were histologically lost.

Scattered through the fibrous tissue of the cyst wall, however, may be found epithelial cells which probably represent the compressed remnants of the original glandular or secreting acini or ducts which caused the milk formation within the cyst.

CASE V—D K, Greek tailor, aged forty-nine years, was admitted to the hospital, May 5, 1925. His history was that a pea-sized lump was noticed in the nipple of the right breast in November, 1921. This increased slowly in size until eight months before admission, when in rubbing his skin after a bath the skin over the lump came off. Bleeding and ulceration followed. For the last four months there has been a sero-purulent discharge from the ulcer accompanied by a disagreeable odor. For a year he has been losing strength, been unable to work, and has sustained a loss of 10 pounds in weight.

## TUMORS OF THE MALE BREAST

During this period there have been night sweats and for the last few months, cough followed by a yellow sputum, which was never blood-tinged. There was no cardiac disturbance, except some dyspnoea on exertion. No oedema of the extremities, no abdominal distress or vomiting, and no hematuria, although he had to get up twice each night to urinate. His habits and family history furnished no information in regard to his present condition.

The physical examination showed a well-nourished man, on whose right breast in place of the nipple was an ulcer 4 by 2 cm. in size, extending down into the pectoral muscle, covered with a bloody pus. This ulcer bled very easily when rubbed and its edges were

very hard, not undermined. Hard, rod-like extensions beneath the skin and probably beneath or in the pectoral fascia could be palpated extending up to the right axilla. In this axilla were both seen and felt enlarged, hard lymph-nodes, under the edge of the pectoralis major. There were several masses of lymph-nodes, the largest nearly 2 cm. in length. The left breast and axilla were normal.

The regional physical examination made by the interne

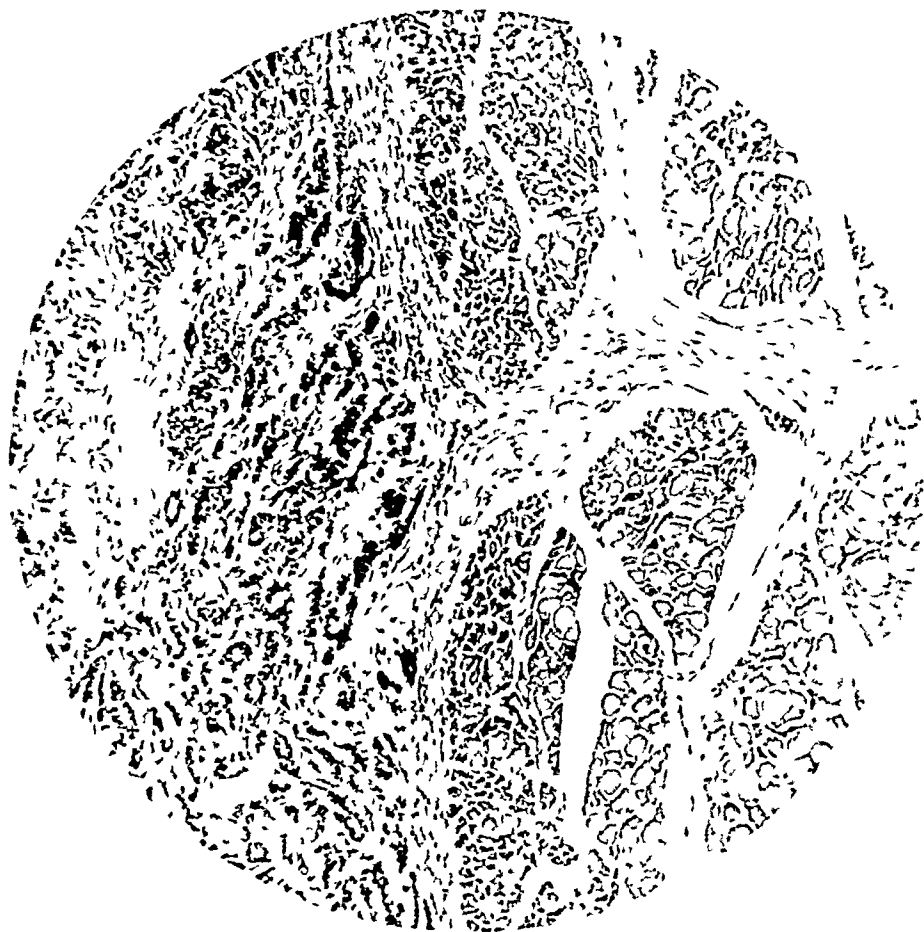


FIG. 15.—Secondary lymphatic invasion in the scirrhus mammary carcinoma of the male. The section was taken from a lymph-node lying beneath the pectoralis major muscles high in the axilla. It was firmly fixed to the muscle and shows leucocytic infiltration probably from infection of the primary cancer ulcer. The scirrhus character is fairly well maintained but the muscle has not yet been invaded.

failed to show any cardiac or chest pathology. Abdominal examination failed to permit the palpation of any organ, although the wall was reasonably lax. There was no ascites. An X-ray examination of the chest was ordered but was never done, although it was reported to me that there was no X-ray evidence of chest pathology which would indicate metastases. The Wassermann blood reaction was negative.

A radical removal of the breast, pectoral muscles and axillary contents was performed May 8, 1925. It was found impossible completely to close the skin after wide excision of the ulcerated area. The patient rallied at first after the operation, but rapidly became weaker with a cough and profuse sputum developing. Death occurred May 16, 1925.

The pathological report on the breast carcinoma specimens removed was: This specimen consists of an amputated breast with the underlying pectoral muscles and the axil-

lary lymph-glands. The skin is elliptical in shape and measures 9 by 15 cm. In the centre is an oval lesion 3 by 5 cm. The border is  $1\frac{1}{2}$  cm wide and deep red in color. The whole area is crateriform in shape, sloping gradually to the centre, which is yellow and 7 mm below the edges. The surfaces of this cavity are finely nodular, but glistening and clear, and there is no evidence of necrosis. The edge of the lesion is ragged and there is a sharp demarcation between the ulcer and the skin. There are a few long black hairs projecting from one edge. This whole area is hard and fixed to the underlying tissues. The firmness extends from 1 to 2 cm out from the edge of the ulcer. On either side, 2 cm from the border of the ulcer, are two discrete nodules 1 cm in diameter. In the centre of each of these is a shallow ulcerated area similar to that in the primary mass described. There is some fatty tissue about  $\frac{1}{2}$  cm in thickness below all the skin. The primary tumor infiltration extends down through this fatty tissue and into the pectoral muscles below it. In the fascia and loose tissues between the pectoralis minor and major are hard discrete nodules up to 1 mm in length. There is an attached clump of axillary glands also infiltrated by firm tumor tissue the largest of these measuring 3 by 2 cm. There is no evidence of a nipple its site being replaced by the large ulcerated lesion. **Diagnosis.** Primary ulcerating scirrhous carcinoma of the breast.

The anatomical diagnosis from the autopsy was: Recent, sutured right radical mastectomy wound, metastatic diffuse carcinomatosis of both lungs, metastatic carcinoma of the right axillary and tracheobronchial lymph-glands, tumor metastases in the liver and pleura, unresolved pneumonia of the left lower lobe, left fibrino-purulent pleuritis, moderate generalized anemia, moderate cloudy swelling of the parenchymatous organs, atheromatous degeneration of the aorta, multiple strictures of the bulb and penile urethra, pyorrhoea alveolaris, cholelithiasis.

Both lungs showed large areas of metastases which would easily have been apparent on X-ray examination. There was carcinomatous involvement of the pleura and liver not extensive, the pneumonia was recent (post-operation). This patient should not have been operated upon in the face of metastases. These should be sought by all clinical means at our disposal before a radical breast amputation is performed although we may believe that generalized and regional metastases in the male follow much later than they do in the female. The size of the lymphatic enlargement in the axilla should be some indication of the possibility of metastases elsewhere if we believe that the blockage there leads to an effort on the part of the carcinoma to spread via more difficult paths.

# BILATERAL MAMMARY CANCER OPERATIONS\*

## ULTIMATE RESULTS IN NINETY-EIGHT CASES

BY CLARENCE A. McWILLIAMS, M.D.

OF NEW YORK, N. Y.

IN CRITICALLY considering the ultimate results following bilateral operations for consecutive bilateral breast cancers, it should be recognized at the outset that there are two distinct classes of patients, first, those in whom the second breast tumor is manifestly a metastasis from the first mammary cancer, evidenced by nodular fascial permeations across the chest, or secondary to node involvement of the second breast. These are simply recurrences after single breast operations, with a very bad prognosis after the second mammary amputation, as is the prognosis with most recurrences, despite all varieties of treatment. The second class comprises those patients whose second breast lesion has no visible connection with the first, having arisen apparently *de novo*, that is, there are no other apparent growths evidenced anywhere else. These are the patients in whom both breast growths may be primary, and the prognosis of which we wish to determine.

Unfortunately, in these reported results of bilateral operations, such a perfect division of patients was impossible to make completely because of the frequent deficiency in the reported details of the lesions. Wherever, however, it was indicated that the second breast tumor was accompanied by skin recurrences, such a patient was excluded from the series.

In the replies to the questionnaire sent out by means of which this report was made up, there were not sufficient details given to state the number of patients who had axillary node involvements, or not. It is the author's intention to still further pursue the inquiry as to the influence of node involvement upon the prognosis, and also to ascertain the pathological similarity, or dissimilarity, between the two tumors in the two breasts. It is hoped that those who have volunteered patients included in this report will have the goodness to send to the author details on these points, that a complete report may be made to this Association at a later date. The author desires to acknowledge the great kindness of those who have given to him the patients which have made this report possible.

In this report there are 98 patients with bilateral mammary cancers, 11 of which were simultaneous, while 87 were consecutive. The frequency (Table I) of bilateral breast cancers (including both simultaneous and consecutive together) is 4.9 per cent of all mammary cancers (in 3132 breast cancers, the bilateral lesions occurred 154 times). Simultaneous bilateral

---

\* Read before the American Surgical Association, May 5, 1925.

cancers occur about once in 500 breast cancers, or 2 per cent and consecutive bilateral cancers 4.7 per cent. As a means of comparison, the writer has collected the results (Table II) of 1720 operations for unilateral breast cancers, of these, 31.6 per cent were alive five years after the single operation, while of the 87 patients (Table V) with consecutive bilateral cancer operations, 47 patients or 54 per cent, were alive five years after the first operation, and 21 patients, or 24.1 per cent, five years after the second operation, which is truly an astonishing finding.

The data as to the ultimate outcomes following operations on these 98 patients for bilateral mammary cancers (Table V) seem to establish

Firstly, that, compared with the ultimate results following operations for *unilateral* mammary cancer, the extreme pessimism current regarding the final results following operations for the *bilateral* lesions is not justified.

Secondly, that the second breast cancer, in probably a large number of patients, is a primary growth, entirely independent of the first breast cancer. The following facts speak for the truth of this hypothesis: (a) Absence of growths (metastases) elsewhere at the time of the second operation in most of the patients.

(b) Histological dissimilarity frequently of the types of the two breast cancers.

(c) Impossibility of simultaneous bilateral mammary cancers having any direct etiological connection between them.

(d) Hopelessness of the prognosis, if we regard the second breast tumor as a metastasis from the first, since recurrences, after unilateral mammary cancer operations, have a very bad prognosis. These statistics of bilateral operative results do not bear this bad prognosis out which strengthens the argument for the primary origin of the second breast tumor.

Theoretically, we may argue that presumably the breasts of normal individuals are structurally alike, at least in the beginning. Most authorities among them Doctor Canel, have given up the idea of the microbic origin of cancer, this theory being superseded by the supposition that its etiology may possibly be due to local irritation plus some constitutional physico-chemical, or electrical change, which influences the erratic behavior of cells. This change may act on the two breasts differently, one being unaffected, or causing a simple mastitis, while in the other breast, cancer may develop. This unilateral effect is the usual result (95.1 per cent of all mammary cancers). In other instances, rare to be sure, simultaneous cancers may be set up in each breast (2 per cent), the poison acting equally at the same time on the two breasts, or the poison may act unequally in time, each breast consecutively becoming cancerous at different times (4.7 per cent of all mammary cancers). Speaking almost decisively for each of the bilateral growths being primary is the fact that many of these cancers are dissimilar histologically, thus, Wiener's patient (Table VIII, No. 62) who had adeno-cancer

## BILATERAL MAMMARY CANCER OPERATIONS

in one breast and scirrhus in the other, with an interval of 11 years between the two operations, the patient now being well, 25 years after the first operation. Likewise, Primrose's patient (Table VII, No 10) with simultaneous cancers, one medullary, the other scirrhus, Hitzrot's simultaneous patient (No 7) had adeno-cancer in each breast. Greenough's consecutive patient (Table VIII, No 69) had adeno-scirrhus cancer in one breast and medullary in the other. McWilliams' patient (No 38) was an instance of a consecutive breast tumor with a six years' interval between the two operations, the tumor in each breast being similar histologically, on neither side was there any node involvement. This patient is alive to-day, 15 years after the first operation and 9 years after the second. In the second breast, there was a distinct mastitis, in which the cancer had developed.

Two influences seem likely to be necessary to cause cancer. First, a local irritation, more or less continuous, probably extending over a long period of time, but this, in itself, alone is not sufficient to cause cancer, for example, witness the fact that all pipe smokers do not acquire cancers of the lip, or tongue, only a few do. To the local irritant must be added some general constitutional influence, possibly some physico-chemical or electrical change. In the above patient of McWilliams, the local irritant produced at first a single chronic mastitis. In the majority of women, this chronic mastitis would not go on to form cancer, lacking the constitutional cause, but in this patient, to the effects of the local irritant, was added the essential, unknown, constitutional cause, and we had two consecutive primary breast cancers develop, superimposed upon double chronic mastitis, coming on probably at different times, for, in the opinion of the author, it is impossible to escape the positive conclusion that in this patient, each breast cancer was a primary growth, neither having gone on to axillary involvements, nor to lymphatic skin permeation recurrences. Possibly in the future, little advance over our present methods will be accomplished in treating cancer *after* it has once developed. Efforts will have to be made to determine the general constitutional cause, elimination of which will prevent the inception of the cancer. This will require deep study of the life history of cells and the causes which influence them to develop rightly or wrongly.

Possibly an analogy may be drawn between the paired ovaries and the paired breasts. It is the writer's impression that if one ovary is found cancerous, the second will either be found cancerous at the same time, or subsequently will probably develop cancer. The only access from one ovary to the other is across the peritoneum, lacking direct lymphatic connections, so there may be some constitutional chemical cause added to local irritation, producing independently like lesions in the two organs at the same time or at different times.

Handley states that in a late stage of breast cancer, owing to extension of permeation across the middle line, enlargement of the opposite axillary

nodes often occurs. A little later, deposits of growth are noted in the opposite breast.

We therefore assume that each one of the bilateral cancers is primary when there are no fascial or skin nodules present across the chest, or no axillary lymph-node involvement on the side opposite to the original breast cancer, and when the cancers in the two breasts are of a different histological type. Contrariwise, it is not obligatory to infer that because the two cancers are of the *same* histological type that the second is necessarily a metastasis from the first, since it would be more reasonable to assume that a general cause, acting equally on like tissues, would produce like lesions with no necessary direct anatomical connection between the two.

TABLE I

*Results in Single Breast Amputations After Five Years*

Judd	150 heard from	30.0 per cent	alive after 5 years
Porter	22 heard from	27.7 per cent	alive after 5 years
Mills	118 heard from	39.8 per cent	alive after 5 years
Sistrunk	218 heard from	36.7 per cent	alive after 5 years
Bunts	695 heard from	16.9 per cent	alive after 5 years
Peck and White	69 heard from	39.0 per cent	alive after 5 years
Greenough and Simmons	69 heard from	32.0 per cent	alive after 5 years
Primrose	76 heard from	44.4 per cent	alive after 5 years
Deaver	150 heard from	26.0 per cent	alive after 5 years
"Total"	1720 heard from	31.6 per cent	alive after 5 years

These figures (31.6 per cent alive of unilateral lesions, after 5 years) are the results of unilateral operations on all cases, late as well as early. A very favorable prognosis is found in node-free patients, in the unilateral mammary cancers. Thus, G. P. Mills, among cases operated by a number of British surgeons, found a 6-year cure in 62.9 per cent of node-free patients, while Sistrunk found 64 per cent alive of node-free patients 5 to 8 years after the unilateral operations. The prognosis depends, then, upon the presence or absence of node involvement, since the operation itself has become standardized, and can scarcely be extended, as Bloodgood says: "If the lump felt by the patient proves to be cancer, its duration is the only controllable factor in the ultimate cure, and the percentage of recurrences after 5 years gradually rises with each two-month period of time between the origin of the growth and the operation." Rodman (*Atlantic Med Jour*, Oct., 1923) says:

1. If a diagnosis is made in the precancerous stage and operation at once performed, 100 per cent of cures will result.

2. If in the stage of microscopic cancer, 72 per cent of cures will result after radical operation.

3. If the diagnosis before operation can be practically certainly made, not over 30 per cent will be cured.

# BILATERAL MAMMARY CANCER OPERATIONS

TABLE II

<i>Frequency of Occurrence of Bilateral Mammary Cancers</i>	
Bunts	Found in 721 patients, 70 bilateral, or 9.6 per cent
Davis	Found in 166 patients, 8 bilateral, or 4.8 per cent
Kilgore	Found in 1100 patients, 37 bilateral, or 3.3 per cent
Primrose	Found in 125 patients, 11 bilateral, or 8.8 per cent
VanderVeer	Found in 269 patients, 8 bilateral, or 2.9 per cent
Dowd	Found in 202 patients, 1 bilateral, or 0.4 per cent
Payne	Found in 190 patients, 3 bilateral, or 1.5 per cent
Lockwood	Found in 166 patients, 8 bilateral, or 4.8 per cent
Braun	Found in 193 patients, 8 bilateral, or 4.1 per cent
Total	In 3132 patients, 154 bilateral, or 4.9 per cent

Judd states that the opposite breast is involved in from 10 to 12 per cent of the late cases

We may say then that 5 per cent of patients with cancer in one breast, in the operable stage, will develop cancer in the opposite breast

Kilgore reports that a patient who has had one breast amputated for cancer is, if she survives 5 years, from three to four times more likely to develop cancer in the second breast than a normal woman of the same age, in either of her two breasts, also that the majority of cancers in second breasts, arising three to four years after the first operation, behave clinically at least like primary new growths—not like a metastasis from the cancer in the first breast

TABLE III

<i>Simultaneous Mammary Cancers</i>	
Bloodgood states that simultaneous cancerous tumors occur in the two breasts about once in 500 patients, or 2 per cent. In the present series of 98 bilateral mammary cancers, simultaneous cancers occurred in the two breasts eleven times, or 11.2 per cent of the bilateral cases. The results of these eleven simultaneous bilateral operations are as follows:	
Living at time of last report	Dead
1 and ½ years	In 4 months
3 years	In 8 months
3 and ½ years	In 1 year
4 years	In 2 years
22 years	In 2 years and 3 months
5	In 4 years
Totals	6

Thus, only 1 of 11 patients with simultaneous bilateral mammary cancers, or 9 per cent, is alive longer than 4 years after the double operations. It is therefore evident that the ultimate prognosis after operations for two simultaneous breast cancers is much more grave than after operations for two consecutively appearing breast cancers (see Table V). The average duration of life of the 6 dead was 1.7 years.



## CLARENCE A McWILLIAMS

TABLE IV

*Lengths of Time Between Operations upon 87 Consecutive, Bilateral Mammary Cancer Patients†*

Living (33)		Dead (54)
2	Six months between operations	8
5	From 6 to 12 months between op	13
7, or 8.3 per cent	2nd operation within 1 year of 1st op	21 or 24.1 per cent
13, or 14.9 per cent	2nd operation within 2 years of 1st op	29 or 33.3 per cent
19, or 21.8 per cent	2nd operation within 3 years of 1st op	37, or 42.6 per cent
21, or 24.1 per cent	2nd operation within 4 years of 1st op	42, or 48.2 per cent
23, or 26.4 per cent	2nd operation within 5 years of 1st op	46, or 52.8 per cent
27 or 31.0 per cent	2nd operation within 6 years of 1st op	48, or 55.1 per cent
0	Between 6 and 7 years	1
2	Between 7 and 8 years	1
1	Between 8 and 9 years	1
1	Between 9 and 10 years	1
1	Between 10 and 11 years	1
1	Between 12 and 13 years	1
33		54

*Totals of Living and Dead Together*

2nd operation within 1 year of 1st operation, 28, or 32.1 per cent  
 2nd operation within 2 years of 1st operation, 42 or 48.2 per cent  
 2nd operation within 3 years of 1st operation 56, or 64.3 per cent  
 2nd operation within 4 years of 1st operation, 63, or 72.4 per cent  
 2nd operation within 5 years of 1st operation, 69, or 79.3 per cent

In 12 patients (13.8 per cent) the 2nd operation occurred between 6 and 13 years after the first

† The percentages are based on the total number of patients (87)

The total statistics (Table IV) have been arbitrarily divided into two classes at the time of the reports, the living and the dead, 33 of the former and 54 of the latter. As has been already shown, simultaneous, bilateral, mammary cancers are much more quickly fatal than consecutive, bilateral cancers. It would be fair to assume, then, that in the consecutive, bilateral cancers, the more quickly the second breast operation approximates the first, the worse the prognosis. This assumption is borne out by the fact that within the first year after the first breast operation (Table IV), the second breast operation was performed three times (21 instances) as often in those who have died as in those who are still alive (7 instances). In succeeding years, the individual numbers in the two classes more nearly approximate each other, the percentages in each year remaining almost constantly about double those of the dead, as of the living, the greatest difference in the figures being mainly due to the difference in the number operated during the first year after the first operation. Totalling the living and the dead, it is found that 32.1 per cent were operated upon for the second breast cancer within 1 year after the first operation, 48.2 per cent within 2 years, and 64.3 per

## BILATERAL MAMMARY CANCER OPERATIONS

cent within 3 years, and 79.3 per cent within 5 years. In 13.8 per cent the second operation occurred between 6 and 13 years after the first

TABLE V

*Results In Time Since the Double Operations Upon 87 Consecutive, Bilateral, Mammary Cancer Patients, Including the 54 Known Dead and the 33 Known Alive*  
*Bilateral Operations*

	After 1st operation	After 2d operation	Sistrunk's statistics of 218 unilateral operations
Lived for 3 years	63 (72.4%)	33 (37.9%)	113 (51.8%)
Lived for 5 years	47 (54.0%)	21 (24.1%)	85 (39.0%)
Lived for 8 years	31 (35.6%)	15 (17.2%)	80 (36.7%)
Lived for 10 years	19 (21.8%)	9 (10.3%)	

11 lived between 10 and 15 years after 1st operation in the bilateral lesions  
 7 lived between 10 and 15 years after 2nd operation in the bilateral lesions  
 5 lived between 15 and 20 years after 1st operation in the bilateral lesions  
 2 lived 19 and 20 years respectively after the second operation  
 1 lived 22 years and 2 are alive 25 years after the first operation  
 None are alive longer than 20 years after the second operation

In attempting to comment on Table V, the author is at a loss to explain the much more favorable results in the 3- and 5-year periods, following the first operation in the bilateral cases as compared with Sistrunk's similar statistics following single operations alone in the unilateral lesions. For, after the first operation in the bilateral cases, 72 per cent were alive at the end of 3 years, as compared with Sistrunk's 51 per cent, and 54 per cent after 5 years following the first operation in the bilateral cases, as against 39 per cent in the single lesion. Eight years after the first operation in the bilateral cases, the ultimate results are about the same in the bilateral cases as in the unilateral lesions (36 per cent). From Table IV, we see that one-third of all bilateral patients will develop the cancer in the second breast during the first year after the first operation, and within two years, one-half will have developed the second breast lesion.

From these statistics (Table V), it is seen that the development of the second breast cancer does not shorten the life expectancy after the 1st breast cancer operation whatsoever, which is further evidence of the primary origin of the second breast cancer. About, roughly, 20 per cent more are alive 3 and 5 years after the 1st operation in the bilateral cases than after the single operation in the unilateral lesions. But as we follow the patients farther along, we find almost the same proportion alive 8 years after the 1st operation in the bilateral cases as 8 years after the single operation in the unilateral lesion (Sistrunk), namely, about 36 per cent alive in each. From this it would seem superficially as though the second breast cancer has a tendency to develop more frequently in unilateral breast cancers, which are slow in their course but which usually lead to the inevitable fatal outcome in the majority of patients ultimately, whether single or bilateral.



## BILATERAL MAMMARY CANCER OPERATIONS

Of the 11 simultaneous cancers (Table VII), 6 are dead the average duration of life of these, after the simultaneous operations, was 1.7 years: 5 are living, only one of whom has lived longer than 1 year excluding the one who is alive 22 years after the operations, the average duration of life of these 5 being 2 years since the operation.

TABLE VII.  
*Results of 11 Simultaneous Bilateral Breast Cancer Operations.*

No	Operator	Date of operation	Length of life between operation and death	If living how long since operation, at last report
1.	Vaughan	10 1902		22 years.
2	Royser.		2 years	
3	Taylor	1 1912	27 months	
4	Codman	7 1901	8 months	
5	Downes	6 1920	1 year	
6	Rea Smith	1 1923		19 months.
7.	Hazrot	1 1922		3 years adeno-cancer in each.
8	Erdman.	3 12 21		1 year
9	Payne.	1 1911-2 1911		3 and 3/4 years
10	Primrose	11 months before death, one breast medullary, other scirrhus	11 months	
11.	Heyd	12 23 '25	1 month	
Average length of life of the dead was 1.7 years				Average length of life of the living excluding the one patient living 22 years is 2 years

### PROGNOSIS OF MAMMARY CANCERS

Improvement in the results of treatment for cancers of the breast will follow the same lines of development as that obtained in acute appendicitis namely early operation before the development of peritonitis in the latter lesion and in the former, early operation before the involvement of the axillary nodes. It is a goal we must all strive for. The laity must be impressed in season and out that, because a lump in the breast is painless this is all the more reason for its extirpation. It should be removed at its inception and the longer the operation is delayed the more gloomy the prognosis, due to secondary involvement of the nodes and skin. The author believes the results of operations for mammary cancers will gradually improve as the laity become more and more instructed as to the necessity of attending

TABLE VIII  
Results of Operations for 87 Consecutive Bilateral Mammary Cancers \*

No	Operator	Date first operation	Date second operation	Length between operations	Result	Length between first operation and death	Length between second operation and death	Length since first operation if alive	Length since second operation if alive
1	Buchanan	1/15/1903	12/9/1903	11 months	Died, 12/12/04	2 years	12 months		
2	Buchanan	7/1899	8/2/1905	6 years	Well, 8/1924			25 years	19 years
3	Buchanan	1/8/1907	1913	6 years	Well, 6/14/17			10 years	4 years
4	Buchanan	7/14/1908	7/10/1913	5 years	Well, 6/10/17			9 years	4 years
5	Buchanan	1/23/1914	12/4/1915	23 months	Died, 5/10/16	23 months	6 months		
6	Pilcher	3/13/1891	1896	5 years	Died, 1899	8 years	3½ years		
7	Pilcher	11/1901	1904	3 years	Died, 1905	4 years	1 year		
8	Pilcher	8/1905	1908	3 years	Well, 1924			19 years	16 years
9	Pilcher	9/1905	4/1908	3 years	Well, 1913			8 years	5 years, no report since 1913
10	Pilcher	10/1906	5/1907	7 months	Well, 1917			11 years	10 years, no report since 1917
11	Pilcher	3/1907	1913	6 years	Died, 1 year later	7 years	6 years		
12	Pilcher	12/1907	1908	1 year	Died, 1 year later	2 years	1 year		
13	Pilcher	7/1911	1922	11 years	Died, 1923	11 years	16 months		
14	Brunsmade	1909	1910	1 year	Died, 1924	15 years	14 years		
15	Bloodgood			1 year	Well, 15 years			16 years	15 years
16	Balch			3 years	Died, 3½ years	6½ years	3½ years		
17	Balch			6 months	Died, 1½ years	2 years	1½ years		

# BILATERAL MAMMARY CANCER OPERATIONS

18	Connors	1921	1921	4 months	Well				3 years 4 months	3 years
19	Jackson			1 year	Died, 3 years	4 years	3 years			
20	Hupp			2 years	Well, 20 years later			22 years		20 years
21	Hupp			5 years	Died, 3 years later	8 years	3 years			
22	Dowd	1906	4/1908	2 years	Died, 3 months later	2 years 3 months	3 months			
23	Wainwright	5/1909	8/1909	4 months	Died, 2 months later	6 months	2 months			
24	Wainwright	11/1912	4/1913	4 months	Died, 4 months	9 months	4 months			
25	Wainwright	3/1915	12/1915	9 months	Died, 4/1916	11 months	4 months			
26	Royster			1 year	Died	3 years	2 years			
27	Royster			1 year	Died	4 years	3 years			
28	Davis	6/20/1913	6/1915	2 years	Well			11 years		9 years
29	Kanavel			8 months	Died	1 year 8 months	1 year			
30	Kanavel			3 years	Died	5 years	2 years			
31	Shupley	1915	1916	6 months	Well			9 years		8½ years
32	Shupley	8/1920	7/1923	2 years 6 months	Well			4 years		15 months
33	Ashhurst	Recurred in	5 months	5 months	Died	9 months	4 months			
34	Harris	1902	1910	8 years	Well			10 years		8 years
35	Eliot	2/5/09	12/28/10	22 months	Well till '24			15 years		13 years
36	Codman	4/1912	3/1918	6 years	Died, 3/02	10 years	4 years			

TABLE VIII—Continued  
Results of Operations for 87 Consecutive Bilateral Mammary Cancers

No	Operator	Date first operation	Date second operation	Length between operations	Result	Length between first operation and death	Length between second operation and death	Length since first operation if alive	Length since second operation if alive
37	Codman	10/1910	3/1913	18 months	Died, 3/15	4 years 6 months	2 years		
38	McWilliams	9/1910	4/1916	5 years 8 months	Well, 1925			14 year	9 years
39	McWilliams	2/1921	4/1923	2 years 2 months	Died, 10/24	3 years 8 months	1 year 6 months		
40	Eliot	5/8/16	3/2/17	11 months	Died, 1 year	18 months	6 months		
41	Eliot	10/30/12	1/14/1916	3 years 4 months	Died	5½ years	18 months		
42	McGuire	1908	1909	1 year	Died, 1909	2 years	1 year		
43	McGuire	1909	3/27/17	8 years	Died, 1/1/18	9 years	9 months		
44	McGuire	7/23/13	11/25/17	4 years 4 months	Died, 5/1920	6 years 10 months	2 years 5 months		
45	McGuire	10/12/16	9/12/17	11 months	Died, 9/5/18	2 years	1 year		
46	McGuire	12/31/18	11/5/19	11 months	Alive, recurrence '24	6 years	5 years		
47	Kellar	1912	1913	6 months	Died, 12/23 "Spinal meta"	11 years	10 years		
48	Rea Smith	2/1914	2/26/1924	10 years	Still alive			10 years	9 months
49	Rea Smith	1915	1/7/22	7 years	Died	8 years 4 months	16 months		
50	Rea Smith	4/25/22	8/11/22	4 months	Died	1 year	7 months		

# BILATERAL MAMMARY CANCER OPERATIONS

51	Royster	3/1/18	11/1/20	21 months	Living			6 years 8 months	4 years
52	Willy Meyer	3/1899	12/1900	1 year 10 months	Well			8 years 1 month	6¼ years
53	Willy Meyer	1908	1909	1 year	Well			17 years	16 years
54	Willy Meyer	6/29/08	3/28/11	2 years 9 months	Well			8 years 3 months	5½ years
55	Willy Meyer	4/19/15	11/5/15	2 years	Died		4 years		
56	Willy Meyer	4/9/16	11/1920	4 years 7 months	Died		6 years		
57	Hitzrot	1906	10/1908	18 months	Died		3 years		
58	Clinton	1916	1917	1 year	Well			9 years	8 years
59	Lyle	6/2/19	12/12/20	1 year 6 months	Died, 9/14/24		5 years 3 months	3 years 8 months	
60	Lyle	11/16/21	12/14/23	2 years	Died, 2/1924		2 years 2 months	1 year 2 months	
61	Lyle	6/10/08	12/15/09	18 months	Well			6 years	4 years, 6 months
62	Wiener	1900 adeno	1911 scirrhous	11 years	Alive			25 years	14 years
63	Payne	2/10/07	1/1910	3 years	Died		4½ years	18 months	
64	Payne	10/1906	11/1911	5 years	Living			18 years	13 years
65	Bancroft	3/1918	4/1922	4 years	Well			4 years	2½ years last report
66	Bancroft	6/28/12	7/8/21	9 years	Living			12 years	3 years, 3 months



TABLE VIII—Continued  
Results of Operations for 87 Consecutive Bilateral Mammary Cancers

No	Operator	Date first operation	Date second operation	Length between operations	Result	Length between first operation and death	Length between second operation and death	Length since first operation if alive	Length since second operation if alive
67	Woolsey	1911	4/14/22	11 years	Died	12 years 8 months	20 months		
68	Greenough	8/28/18	11/23	5 years 3 months	Well			7 years 4 months	2 years
69	Greenough	11/10/20 adeno scurhus	6/20/24 medullary	3 years 7 months	Well			4 years	4 months
70	Primrose			8 months	Died	3 years	2 years 4 months		
71	Primrose			1 year	Died	1 year 10 months	10 months		
72	Primrose			1 year 4 months	Died	2 years 7 months	1 year 3 months		
73	Primrose			1 year 6 months	Died	2 years 2 months	8 months		
74	Primrose			2 years	Died	2 years 5 months	5 months		
75	Primrose			2 years 2 months	Died	2 years 10 months	8 months		
76	Primrose			2 years 8 months	Died	4 years 4 months	1 year 4 months		
77	Primrose			2 years 10 months	Died	8 years	5 years 2 months		

# BILATERAL MAMMARY CANCER OPERATIONS

78	Primrose	11/1910	3/26/23	12 years 4 months	Died		14 years	1 year 6 months		
79	Peterson	6/3/09	11/10/22	13 years 5 months	Well				15 years 8 months	2 years 3 months
80	Peterson	7/1919	7/1920	1 year	Well				5 years 8 months	4 years 8 months
81	Peterson	4/27/1921	12/18/22	1 year 8 months	Well				4 years	2 years 4 months
82	Brewer	6/30/1914		8 years 3 months	Died		11 years	2 years 9 months		
83	Darrach	7/1911	12/1911	6 months	Died		10 years	9 years		
84	Peck	2/14/17	7/10/21	7 years 5 months	Living				8 years	7 months
85	Presbyterian Hospital	12/16/1914	12/16/1916	2 years	Living				3 years 3 months	1 year 3 months
86	Heyd	8/30/1920	10/1922	2 years	Died		2 years 6 months	4 months		
87	Heyd	1/1919	9/1922	3 years 4 months	Died		3 years 8 months	4 months		
	Average in years						49	23	108	72

The average duration of life of the entire 87 patients is 7 2 years after the first operation and 4 2 years after the second operation

\* Patients in this table who have recurrences at time of report are classed as died at that date. Of those who are alive without recurrences length of life is calculated up to date of last report

to tumors of the breasts immediately. To him it is a very encouraging thought that, if we operate on these tumors before axillary node involvement, 65 per cent will be alive after 5 years. The profession generally must be instructed not to temporize with these patients, with local applications, X-rays, radium or what-not, but to seek immediately the only possible means that give hope of a lasting benefit, namely, wide operative removal of the tumor with the axillary nodes. After surgery has done all that it can, post-operative X-ray treatments should be instituted, these being given not with any expectation of killing any chance cancer cells which may have been left, but with the idea simply of *delaying* their progress and development.

It must not be overlooked that the average age of death in this country is now 58 years. Over 50 per cent of mammary cancers occur in women over 50, so that if the laity can be sufficiently instructed to have these tumors removed early before node involvement takes place 65 per cent of them will be alive from 5 to 8 years after operation, at which time they will have arrived at the age of the general American community.

#### PRE-OPERATIVE AND POST-OPERATIVE X-RAY TREATMENTS

The author believes that he voices the great disappointment of surgeons in not obtaining more definite good results in treating recurrences after operations for mammary cancers. How frequently it happens that post-operative recurrences appear directly in the region where powerful radiation has been applied, which gradually increase in size despite all degrees of radiation. When a patient with a cancer of the breast comes to the surgeon, it is usually late. In Sistrunk's statistics of 218 unilateral cancers, in 60.5 per cent the axillary nodes were already involved. With such involvements, only 19 per cent were alive from 5 to 8 years after the operation, while in those without such involvement, 64 per cent were alive from 5 to 8 years after the operation. So that the involvement, or non-involvement of the nodes, seems to be the greatest factor in the prognosis following operation. Is it not then foolish to still further delay from two to four weeks in order to give pre-operative X-ray treatments, during which time the axillary nodes *may* become involved, if they are not already affected, and if they are already involved, the delay will only allow further extensions of the process to take place?

That pre-operative X-ray treatments because of the large area to be radiated can appreciably influence favorably both affected axillary nodes and breast tumors without unduly delaying the only possible hope of a cure, namely, operation, stretches one's credulity. The author begs leave to quote an acknowledged authority on the subject of X-ray treatments in mammary cancer, one who is not previously prejudiced for or against such treatments.

Dr. Francis Carter Wood (*ANNALS OF SURGERY*, February, 1925, p. 559) says "There is no real scientific or clinical knowledge which permits final judgment on the value of pre-operative radiation. There are many assumptions made by radiologists that have no foundation in fact, one being, for

## BILATERAL MAMMARY CANCER OPERATIONS

example, that radiation closes the lymphatics. Clinically, it should be perfectly evident that pre-operative radiation does not close the lymphatics as invasion of skin areas after heavy radiation is not infrequent. Experimental work has also shown that lymphatics in animals cannot be closed by the X-ray, although the terminal arterioles can be. Another objection is that the cancer cells cannot be seriously damaged without equal damage to the surgical field. If 50 per cent of the cancer cells are killed, 50 per cent are left in perfect health at a sacrifice of one to two weeks' time. If the tumor shrinks the patient may refuse to be operated on at all. But there is no evidence that sufficient damage is done to the tumor cells to warrant the delay in using pre-operative radiation. If all the cancer cells could be killed, surgery would be unnecessary. From a practical point of view, therefore, the procedure has nothing to recommend it.

"As to post-operative radiation, that is also somewhat in the experimental stage, but on a much firmer footing because one does see superficial recurrences disappear. Only long clinical experience can determine its final value. One thing, however, the surgeon seems to forget in criticizing the failures the X-ray cannot make cancer grow where cells have not been left.

"In general, it is best to remove the tumor surgically up to the border line of operability and then ray. More skin should be removed than is commonly done, for better results, as regards skin recurrences, are obtained when large areas of skin and fascia are removed. Then all patients should have post-operative radiation for at least two years. It can be done cheaply and effectively without interfering with the patient's work. But there is one very important phase in all post-operative radiation. Once a primary or recurrent tumor has been radiated and has become quiescent, it should not be excised, for rapid and extensive recurrence is apt to follow. Old channels are opened and passage of the tumor cells into the rest of the body is brought about by the surgical procedure."

### RÉSUMÉ

1 In 1720 operations for unilateral mammary cancers, 31.6 per cent, were alive 5 years after the first operation, taking all cases as a whole.

2 About 65 per cent of patients with unilateral mammary cancers with no node involvement will be alive 5 years after the operation.

3 In 3132 patients with breast cancers, bilateral mammary cancers occurred in 5 per cent (simultaneous 2 per cent, consecutive 4.7 per cent).

4 Of 11 simultaneous cancers, only one is alive longer than 4 years, indicating a much more grave prognosis following operations for simultaneous cancers than for consecutive bilateral lesions. The average duration of life of those who have died after the two simultaneous operations was 1.7 years.

5 The nearer the second operation, in the consecutive bilateral lesions, is to the first, the worse the prognosis. Three times as many of those who are dead were operated upon for the second breast lesion within one year after the first breast cancer operation, as of the living.

6 Of the 87 consecutive, bilateral mammary cancer patients, 72.4 per cent are alive 3 years after the first operation, and 37.9 per cent after the second breast operation, alive for 5 years are 54 per cent after the first operation and 24.1 per cent after the second operation, while alive 8 years after the first operation are 35.6 per cent, and after the second 17.2 per cent. These figures indicate that the prognosis for living 3 and 5 years after the first operation, in the bilateral lesions, is much better (20 per cent) than after the operations for an unilateral mammary cancer. The reason therefore is not clear.

7 Patients usually come late to operation with mammary cancers. About 60 per cent already have axillary node involvement, which involvement decreases the 5-year cures by 30 to 40 per cent. Hence the uselessness of further delaying operation for pre-operative X-ray treatments, since there is no scientific nor clinical evidence that sufficient damage is done to the tumor cells in the breast or lymphatic nodes to warrant delay.

8 In the consecutive, bilateral mammary cancers, the average duration of life, after the first operation of those who have died, was 4.9 years, and after the second operation, 2.3 years, of the living, the average duration of life after the first operation is 10.8 years and after the second operation, 7.2 years.

9 Speaking for the primary origin of many of the second breast cancers are

- (a) Absence of metastases elsewhere
- (b) Histological dissimilarity of the two tumors
- (c) Impossibility of simultaneous mammary cancers having any connection between them
- (d) Hopelessness of the prognosis (not borne out by these statistics) if we regard the second breast tumor as a metastasis from the first

## PSEUDO RECURRENCES AFTER RADICAL AMPUTATION OF THE BREAST FOR CARCINOMA

BY ALEXIS V MOSCHCOWITZ, M D  
OF NEW YORK, N Y

LOCAL recurrences after amputation of the breast are as a rule easily diagnosticable. About five years ago I had an experience which proved to me that not every tumor situated in or near the cicatrix after a radical breast amputation represents a local recurrence. My error in diagnosis in this case made a profound impression upon me, and placed me on my guard, so that when I saw two other cases in subsequent years I was enabled to recognize the correct nature of these tumors, although I had difficulty in convincing some excellent colleagues that these were not true recurrences. I deemed these cases therefore as worthy of being placed on record, for their correct recognition is obviously of the highest importance.



FIG 1 —Cyst with fibrous wall, cavity is filled with adipose tissue. On the inner side of the wall scattered in various portions are giant cells of the foreign body type.

These "recurrences" are characterized by the appearance within the operative field of tumors which are exceedingly firm and of a bony hardness closely simulating that of scirrhus carcinoma. They vary in size from a pea to a centimetre or more in diameter, and are located either within the skin or subcutaneous fat. They may be adherent to the chest wall itself. In two of my cases the nodules were in or near the axillary portion of the scar, in the third case the nodule was adherent and immovable on the chest wall. The nodules are not tender, the skin overlying may or may not be adherent. They do not apparently increase in size in the course of many weeks' observation. They are circular or slightly elliptical or irregular in shape. Upon excision even gross inspection fails to reveal the characteristic appearance of malignancy. There are apparently two varieties: (1) Small circular masses of compact fibrous tissue. (2) Small circular cysts with a well-developed fibrous wall containing gelatinous-like contents. The microscopic appearance

will be discussed later. I have called these tumors "pseudo recurrences" or foreign body cysts.

## CASE REPORTS

CASE I—Katherine S. consulted me April 7, 1920. Several months ago she noticed a slowly increasing tumor in the right breast. Physical examination revealed a tumor the size of a hazel-nut with extensive glandular involvement. April 14 radical amputation of the breast by the Willy Meyer method. April 28, discharged well. No post-operative radiation.

July 7, 1920, the patient again consulted me and stated that a few days before she noticed a small mass near the middle of the cicatrix. This mass was very firm and hard, neither painful nor tender and gave all characteristics of a recurrence.

July 14, in local anesthesia, the entire mass was excised down to the ribs through an elliptical incision. The excised specimen showed a small cyst containing a little grumous material with a very thick firm capsule. Unfortunately no microscopic examination was made.

CASE II—T. F. fifty years of age, was first seen by me July 4, 1922. Three weeks ago a small lump was noticed in the left breast. In view of the fact that a similar lump disappeared from the right breast on a previous occasion, the present mass was kept under observation for a while. Three days before admission to the hospital an infiltrated gland was palpated in the axilla.



FIG. 2.—Typical giant cell along the fibrous wall of the cyst in Fig. 1.

July 5, 1922, typical amputation of the breast. Pathological examination by Doctor Mandlebaum is as follows: "Microscopical examination of the tumor removed from Mrs. F. shows a scirrhous carcinoma arising from duct epithelium. Some of the ducts are filled with a necrotic secretion containing lime salts and cholesterol, therefore the process has existed for a considerable period of time. The axillary lymph-nodes are extremely involved."

Primary union was obtained and the patient was discharged with a completely healed wound in eleven days. She then received post-operative radiation. At this time already there was noted a small nodule adherent to the chest wall approximately in the mid-axilla. Soon thereafter two or three other nodules appeared on the humeral portion of the cicatrix. All of these were regarded as a recurrence by several colleagues who saw her, but I suspected otherwise, for I did not recall ever having seen a local recurrence follow so soon after a radical operation.

In October, 1923, I insisted upon the excision of these nodules in order to clarify the feeling of uncertainty in the minds of both the patient and several colleagues who saw her with me. This was accordingly done with local anesthesia, ideal primary union

## PSEUDO RECURRENCES OF BREAST CARCINOMA

resulted, but within three weeks the cicatrices, presumably on account of the preceding radiation, slowly broke down and healing was exceedingly slow

The excised material was submitted to Doctor Mandlebaum, who rendered the following report

"The material submitted consists of three narrow strips of skin with subcutaneous fat, with a nodular mass embedded in each, the smallest being 4 mm in diameter and the largest 8 mm in diameter. A cross-section through each of these nodules shows a cystic cavity surrounded by a thin wall of connective tissue. Two of the cysts are filled with and surrounded by fat, the third one, however, which is directly below the skin, appears to be empty.

"Microscopical examination shows a rather interesting picture. The two larger cysts are limited by a thin wall of long branching strands of fibrous connective tissue, the seat of hyaline degeneration.



FIG 3 —Portion of cyst wall containing fat crystals

Attached to the inner wall one notices an occasional giant cell of foreign body type. The cyst is filled with fat, apparently normal in character, but here and there one notes some degeneration and a few fatty acid crystals arranged in a fan-like or feathery form. These crystals, evidently the end result of a chronic inflammatory process or some form of irritation, are more marked in the empty cyst directly beneath the skin than in the larger cysts in the adipose tissue proper.

"The process, in all probability, is due to the presence of some foreign body, with a secondary reaction and the formation of a fibrous connective-tissue wall of a protective nature."

FIG 4 —Section of wall showing foreign body giant cells. Near the lower angle there is to be seen a black line, a foreign body possibly silk or catgut.



CASE III — LENA V  
forty-six years of age, was

referred to me by Doctor Abel, in December, 1923, for a small tumor in the left breast



of one year's duration. The corresponding axillary glands were greatly enlarged.

December 18, 1923, radical amputation of the left breast. January 14, 1924, discharged well. The pathological report of the excised specimen by Doctor Mandlebaum reads "Scirrhus carcinoma of the breast with involvement of the axillary lymph-nodes." Patient received no post-operative X-ray treatment.

November 14, 1924, the patient accidentally noticed a small tumor near the outer margin of the cicatrix of the previous operation, the location of which was approximately in the mid-axilla. I found an exceedingly firm, not tender mass about one centimetre in diameter, a second smaller mass was found in the cicatrix at about its middle. Both tumors gave me the impression of a carcinomatous recurrence.

November 19, 1924, in local anesthesia excision of a wedge-shaped mass of tissue including the overlying skin and all of the fat surrounding the mass palpated prior to the operation. A similar procedure was carried out on the smaller anterior mass.

The subsequent very careful examination by Doctor Mandlebaum is as follows:

"The specimen consists of a small rather firm, nodule surrounded by fat. Microscopical examination of this nodule shows a loosely woven connective-tissue stroma infiltrated with a large number of lymphocytic cells and an occasional polymuclear cell in other words a chronic inflammatory process mild in character. The interesting feature however is the presence of several foci of large giant cells of foreign body type.



FIG. 5.—High power section of Fig. 4 showing foreign body.

In some of these foci one sees short strands of deeply staining material with parallel borders entirely surrounded by phagocytic giant cells. There is no doubt that the strands are foreign bodies. Whether they are cotton fibres or unabsorbed ligature material one cannot determine with any degree of accuracy, but the lesion is quite characteristic of an irritative inflammatory process due to the presence of a foreign body.

It is very surprising that the condition described is not encountered more frequently. On the other hand, if it is encountered it is astonishing that so little attention has been paid to it that no one has found it worth while to report it. A fairly comprehensive search of the literature by my adjunct Doctor Colp, failed to reveal a single instance in relation to carcinoma of the breast, in fact, this search revealed only a single reference which discussed a related occurrence.

GADE (Falsche Geschwulstrecidive Verursacht durch Einheilung von Aseptischen Fremdkörpern (Verbandstoffen) Deutsche Medizinische Wochenschrift, 1896, p. 430), reports two cases of which case two is of particular interest. The patient was a young woman, twenty-nine years of age, upon whom a tumor the size of a pea was extirpated from the mucous membrane of the cheek, just at its junction with the superior maxilla.

## PSEUDO RECURRENCES OF BREAST CARCINOMA

No microscopic examination was made of the specimen. About one month after the operation this patient again presented herself to her physician with a tumor at the site of the previous one.

The new tumor, somewhat larger than the first one, was also extirpated. On section it was of a peculiar yellowish color and had a homogeneous succulent appearance which, considering the very rapid recurrence, was exceedingly suspicious of a carcinoma. The microscopic appearance, however, spoke absolutely against it, the main mass consisted of young connective tissue with numerous cell masses. On close inspection numerous cotton threads, surrounded by leucocytes and giant cells were to be seen within these cell masses.

In concluding his article Gade states that he assumes that such false recurrences cannot nowadays (1896) be very rare. If the microscopic examination is not made, these recurrences may give rise to a suspicion of malignancy and not infrequently also to needless worry and anxiety.

### CONCLUSIONS

- (1) Three cases of pseudo recurrences after radical extirpation of the breast for cancer are reported.
- (2) These pseudo recurrences simulate physically true recurrences.
- (3) They possess the following characteristics:
  - (a) They appear very soon after the operation.
  - (b) They are situated within or very close to the cicatrix.
  - (c) They are painless and hard.
  - (d) They do not increase in size.
- (4) Microscopically they represent foreign body cysts. The foreign body being either a catgut ligature or a gauze thread.

# ETIOLOGY OF CANCER OF THE STOMACH\*

A REVIEW OF ONE HUNDRED SIXTEEN CONSECUTIVE CASES OF CANCER OF THE STOMACH WITH PARTICULAR RELATION TO ETIOLOGY

By HUGH CABOT, M D

AND

GEORGE C ADIL, M D

OF ANN ARBOR MICH

THE first known reference to carcinoma of the stomach developing on a preexisting ulcer was made by Cruviellhier in 1839, when he said that a simple ulcer of the stomach in people suffering from "diathese cancerouse" might change into cancer. This was followed three years later by the statement of Rokitansky in which he observes that ulcer appears together with cancer and in that case as a rule it is easy to see that the carcinoma had its origin in ulcer. Dittich, in 1848, examined 160 cases of gastric carcinoma and only in one case did he find carcinoma in the margin of an ulcer, and even this he regarded as a coincidence. Steiner and Wollman in 1868, Meyer in 1874 and Lebert in 1878, all agreed with Cruviellhier that carcinoma developing on an ulcer only rarely exists. A sudden transition to exactly the opposite view was made in 1882 by Zenker, who proposed the idea that all gastric carcinoma originated in ulcer. During the following year, Hauser, a pupil of Zenker's, published an extensive investigation on the subject. From his morphological description, Hauser maintained that the atypical epithelial changes in ulcer of the stomach were pre-stages of cancer. However, Friedlander and Cohnheim have

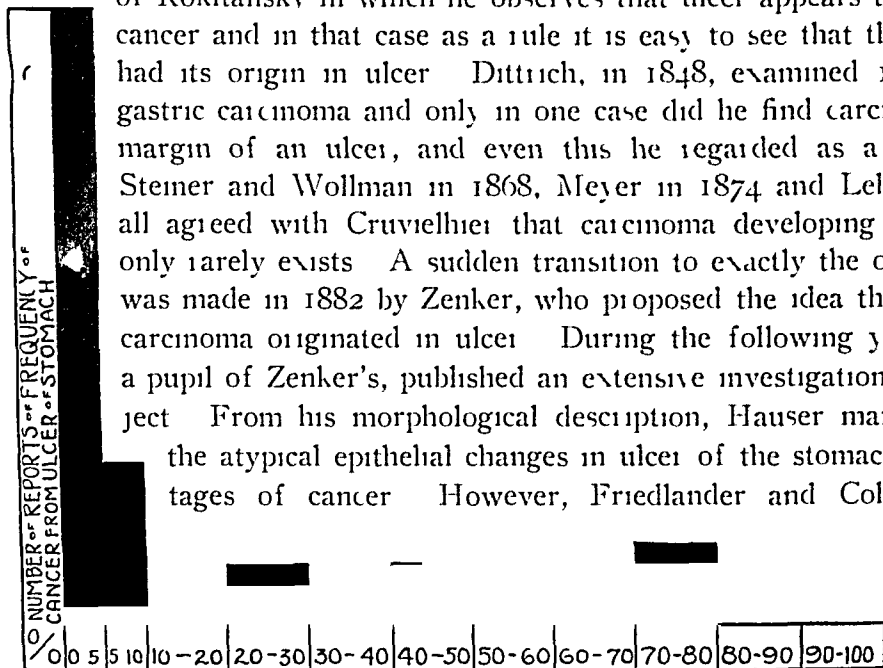


FIG 1—1906 to 1915

shown that the morphology of epithelial

proliferation is not limited to the stomach and ulcer, but that, at any place where chronic irritation causes the formation of granulation tissue and where epithelial tissue is present, an epithelial proliferation may appear, which frequently results in an atypical and to a certain degree, cancer-like appearance.

Tripier and his pupils, Duplant and Saneroth, in 1900, from morphological and clinical observations, advanced the theory that the ulcero-cancer was not a simple gastric ulcer with carcinomatous degeneration, but a cancer, which in many respects bears a resemblance to the *ulcus rodens* of the skin. The growth of a gastric carcinoma is so slow and its tendency to ulcerate so

\* Read before the American Surgical Association, May 4, 1925

## ETIOLOGY OF CANCER OF THE STOMACH

pronounced, that it is often difficult to find carcinoma cells in the lesion Tripiier did not produce any scientific evidence to support this view, merely stated it as a theory It was not regarded very highly in France because of the opinions of such men as Bouvert, Dieulafoy, Mathieu, Hayem and Audistère, who all stood for the cancer *ex ulcus* theory

Without doubt, the theory that has caused the most discussion and led to a great deal of work on the subject, is the one claiming the development of carcinoma in a preexisting ulcer of the stomach From a fairly comprehensive review of the literature there are found at least 82 writers

who are willing to commit themselves to figures estimating the frequency of this occurrence The percentages of frequency vary from 0 to 100 per cent These reports extend over a period of 77 years, the first one being given by Dittrich in 1848 He placed the estimate at 5 per cent During the next 34 years there are only four estimates, two of which are below 10 per cent, one at 40 per cent, and one at 100 per cent, which was given by Zenker The last is the only 100 per cent which appears in the literature Within the next 18 years there were six more reports, all of which were under 15 per cent This brings the reports up to

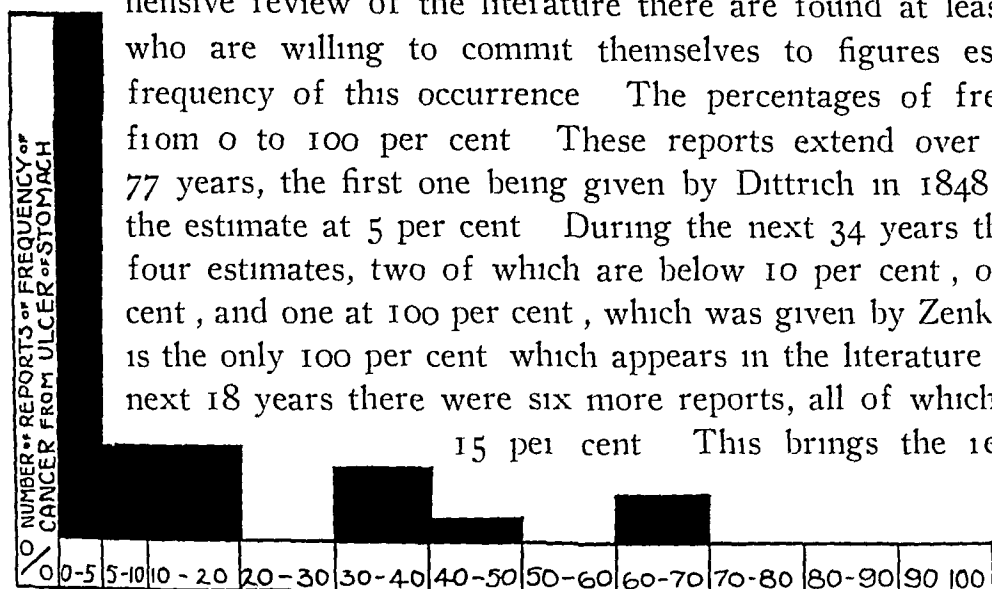


FIG 2 — 1916 to 1925

1900, making a total of eleven in all The

majority of the work has been done since that time with perhaps the greatest amount in the decade between 1905 and 1915 Since 1900, there appear in the literature 71 articles in which an estimate is given, varying from 0 per cent to 90 per cent It is interesting to note that between 1905 and 1915 there are 38 articles, while between 1915 and 1925 there are 22 articles (Fig 1) To analyze briefly the figures quoted in the former decade, we have of those under 5 per cent fifteen, or 39 per cent, under 10 per cent 19, or 50 per cent, from 10 to 15 per cent one and from 15 to 20 per cent none, or under 20 per cent twenty, or 52 per cent, from 20 to 30 per cent three, from 30 to 50 per cent four, or under 50 per cent twenty-seven, or 71 per cent From 50 to 80 per cent eleven, or 28 per cent (Fig 2) In other words, there are approximately twice as many men believe that the development of carcinoma from ulcer is below the small number of 10 per cent as there are those who believe the frequency is between the high percentages of 50 and 80 To analyze the whole number of reports found, which is 82 we find 39 per cent of men estimating the frequency under 5 per cent, 50.6 per cent under 10 per cent, as compared to 18 per cent of men who estimate the frequency to be over 50 per cent (Fig 3) Figures, in this case, of course, do not prove that the occurrence is necessarily low, but in the face of such strong evidence it is very difficult to believe that the frequency is anywhere near as high as some reputable authorities would have us believe

The crucial point in the whole question of the frequency of occurrence of cancer from ulcer lies in the individual differences in the determination of the pathology. This involves the criteria upon which the diagnosis is made.

Examination of about 150 articles shows a surprising lack of harmony in the criteria. Until pathologists and surgeons adopt a uniform standard for the interpretation of the microscopic picture, there will always be a wide diversity of opinion, and furthermore until such an agreement is reached we shall not be in a position to say with approximate accuracy the frequency of development of carcinoma on an ulcer basis.

In this phase of the etiology of cancer as in every other disease process which has been reported in the literature for a great number of years the records show calamity howlers as well as those who are more modest in their beliefs. The pendulum has swung from 5 per cent in the beginning up to 100 per cent back again to less than 5 per cent, then up to 90 per cent and down again to 0 per cent, once more rising to 80 per cent and in the last few years apparently it has stopped swinging through such a large arc and seems to have settled around 5 per cent. It appears to be quite content to confine its motion to figures less than 10 per cent. (Fig 4)

Zenker who believed that all carcinoma of the stomach arose in a preexisting ulcer was quite alone in that opinion. Ssapesushka who at one time gave the opinion that 90 per cent of cancer of the stomach arose from ulcer suffered alone in that belief. Perhaps more than anyone else who preached the gospel of high percentages, MacCarty of the Mayo Clinic in 1909, did the most to spread the doctrine that gastric ulcers in at least 72 per cent of cases would become carcinomatous. He kept hammering this point home for several years gathering many followers, particularly among the surgeons, until finally the opinions of those who would not be led began to assert a definite influence.

That there are men of considerable experience who do not agree with MacCarty is evidenced by the following facts:

Spilsbury definitely states that the Mayo criterion of

isolated cells detached from the regenerating epithelium and buried

NUMBER OF REPORTS OF FREQUENCY OF CANCER FROM ULCER OF STOMACH

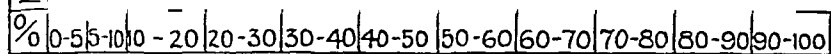


FIG 3 — 1843 to 1925

in the fibrous tissue is not necessarily correct. He goes further even, in pointing out that processes of irregular regeneration are mistaken for malignant transformation by many.

Aschoff, whose opinion is extremely valuable, does not state definitely the

## ETIOLOGY OF CANCER OF THE STOMACH

percentage of occurrence, but does say, in 1911, that the transformation of a simple ulcer into cancer is not as frequent as it has been variously assumed

Anschutz, in 1912, said that the Mayo group lay great stress on the history of preexisting ulcer which in his opinion was of little value MacCarty shows very pretty pictures and gives exact histological descriptions, but even then he cannot be convinced in this important question He is not able to join in opinion with MacCarty that 70 to 80 per cent of carcinoma develops on known ulcer basis, but gives as his own opinion that the number of cases

that one can say with precision developed from an ulcer basis is very small As late as 1920 he believes that the highest percentage of carcinoma from ulcer is from 3 per cent to 5 per cent

Aaron, in discussing carcinoma of the stomach, quotes Wilson and MacCarty as concluding that practically all carcinomata develop on the site of a previous ulcerative lesion of the gastric mucosa and adds that this report is not in accord with his clinical experience Aaron also quotes A Kocher, who says that he has personally examined the Mayo specimens and is convinced that much of what they labeled cancerous degeneration of ulcers was in reality merely atypical proliferation of epithelium, or only epithelial changes in the progress of the ulcer and have nothing to do with carcinoma

Ewing, in 1918, says that MacCarty uses as evidence of carcinoma, inflammatory hyperplasias and misplacement of gastric glands, which may well be grouped under precancerous conditions, but that is no evidence that they develop carcinoma

Spilsbury and Ewing have both emphasized the observation that if the base of the ulcer is infiltrated with carcinoma the lesion has been carcinoma from the start

Bartlett adds another observation which may well be included in the criteria It is that in gastric ulcer the muscle coat is completely destroyed in the base while with carcinoma this but rarely happens, hence if there were well-defined portions of muscle in the base of a carcinomatous lesion, it is strong evidence that the neoplasm did not arise in the edge of an ulcer

Konjetzny, in 1913, in speaking of MacCarty's work of 1909, says the description is so fragmentary and scanty, so purely subjective, that not in

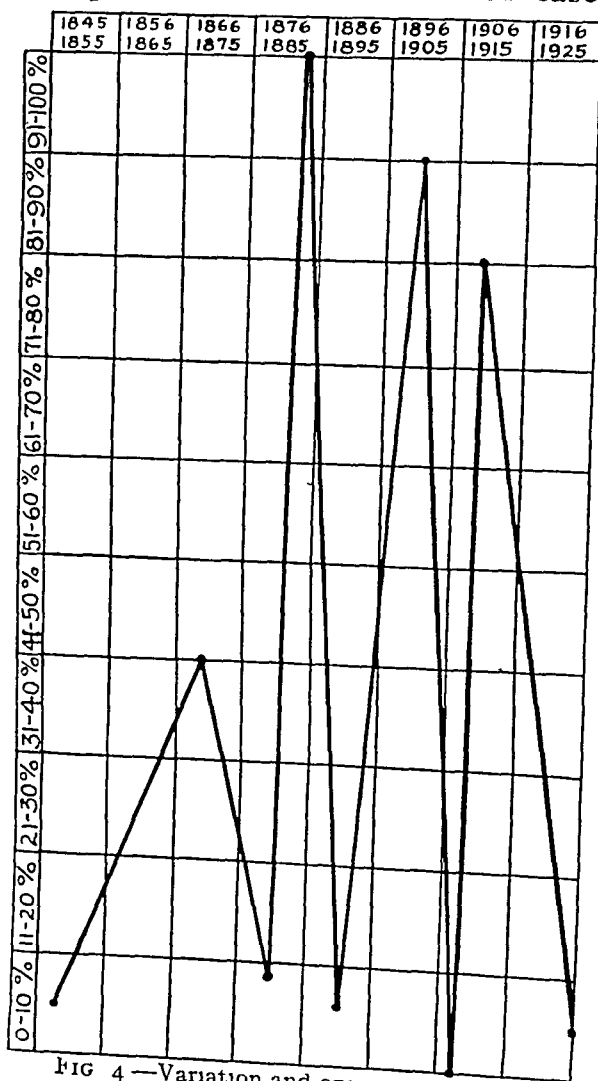


FIG 4 —Variation and opinion since 1848

a single instance does it suffice or satisfy even a moderate claim. As to the question how frequently does carcinoma develop from an ulcer, the work of MacCarty and Wilson is worthless.

As has already been pointed out, the percentage of frequency of carcinoma from ulcer varies from 0 to 100 per cent, according to the pathologists who have reported on this subject for the last 75 years. That there is such wide divergence of opinion is only evidence of the lack of standardization of criteria. In addition to the microscopic evidence we must examine the clinical aspects and attempt to bring them nearer together. The most important feature of the clinical side of the question according to some authorities seems to be the history of the patient, that is the evidence by symptoms that a gastric ulcer has existed for a certain period of time, usually more than five years, previous to the appearance of the typical gastric carcinoma picture. This particular point also seems to be somewhat in doubt. There are those who lay great stress upon the ulcer history and others who claim that it is very difficult to make a diagnosis of ulcer from the history, some who say even that any patient with gastric symptoms may be made to give practically an ulcer history by the clever presentation of leading questions. Then there is always the possibility of a typical gastric ulcer history really being that of duodenal ulcer.

Lockwood, in speaking of the 70 per cent frequency of cancer from ulcer which is claimed by some, maintains that the pathological findings are at variance with the clinical observations, namely, that the history of preexisting ulcer is not present in 70 per cent of carcinoma cases. He finds 7 per cent of cases with a suspicious history, while only 3 per cent have a positive history. Lockwood also points out the change in the ideas of Mayo-Robson who in 1901 wrote, "It is, however, rare to elicit a history of very old standing stomach disorder. The first evidences of local disease appear suddenly in persons of perfectly sound health and robust digestion." In 1907, only six years later, Mayo-Robson writes, "In no less than 59.3 per cent of carcinoma of the stomach on which I have performed gastro-enterostomy for the relief of symptoms, the disease having advanced too far for gastrectomy, the long history of painful dyspepsia suggests the possibility of ulcer preceding the onset of the malignant disease." Lockwood comments on the pretty rapid and radical change of ideas.

Moynihan, in 1909, says that two out of three cases of carcinoma operated by him had a history of previous ulcer. In 1906, he found in one group of 22 patients, 72.1 per cent of ulcer preceding cancer. McDowell, in 1919, says that it seems probable that gastric cancer rarely develops except at the site of a previous ulcerative lesion of the mucosa and that the clinical and pathologic data of the development of gastric cancer on gastric ulcer are in close agreement with regard to, one, the average age of the patient at operation, two, the average period of previous history of ulcer, three, the average number of months of acute symptoms.

## ETIOLOGY OF CANCER OF THE STOMACH

Taylor and Miller find a history of preexisting ulcer in 17 per cent of a group of 182 cases

Osler in 150 cases found ulcer history in 26 per cent and in not a single instance could it be positively diagnosed Fenwick, found 3 per cent ulcer history in his cancer cases, Haberlin 23 per cent and Eichhorst 2 per cent

As evidence tending to show that cancer does not develop from ulcer with great frequency, we may briefly review those cases in which a gastro-enterostomy has been done for simple ulcer and the patients observed for

TABLE I  
*Age Incidence*

Age	Cases	Per cent	40 to 60	50 to 70	40 to 70
15-19	1	0.86			
20-29	4	3.44			
30-39	13	11.2			
40-49	18	15.5			
50-59	42	36.2	51.7		81.0
60-69	34	29.3		65.5	
70-79	3	2.5			
80-89	1	0.86			
Total	116				

several years after Paterson finds that death from carcinoma after gastro-enterostomy for simple ulcer is rare, in his own cases 1 per cent Kocher in 50 cases of gastro-enterostomy for simple ulcer one to twelve years after found no cases of malignancy He later adds 30 cases to the already published 50, making 80 in all, and still finds no case of carcinoma developing after operation for ulcer Billeter, in reporting 122 cases of ulcer, had 6 deaths, 4 resections in which no malignancy was found, 112 gastro-enterostomies in which only one carcinoma developed after operation Greenough and Joslin had one carcinoma out of 114 gastro-enterostomies, Hemmeter had three out of 232 gastro-enterostomies Bamberg, in 1909, reported 1025 gastro-enterostomies for ulcer and found that 21 per cent developed cancer subsequent to the operation for ulcer Of 152 cases of gastric ulcer in which resection was done, 19 per cent subsequently developed carcinoma Gressot reports a percentage of 23 of carcinoma developing after operation for ulcer, presumably gastro-enterostomy Sherren operated 200 cases of gastric ulcer, performing gastro-enterostomy, and in no instance did he find carcinoma developing after operation Rehfus, in 1924, reports his percentage as one to two Exalto, in 1918, found two out of 208 cases

The group of cases here considered is that coming to the Surgical Service of the University of Michigan Hospital from 1916 to 1925 They include



# CABOT AND ADIE

only cases in which the facts have been demonstrated by operation and many of them checked by the pathological report We are quite aware that this is not a large series of cases, but we think it justifiable to consider them particularly in their bearing upon the question of relation of ulcer to cancer

Table I shows the age incidence and does not importantly depart from the figures of other observers It shows, as have others, that the condition is most common at or after middle life, 51 per cent of the cases falling between the ages of forty and sixty and 81 per cent between the ages of forty and

TABLE II  
*Duration of Symptoms According to Age of Patient*

	2 mo	4 mo	6 mo	9 mo	12 mo	18 mo	2 yr	3 yr	5 yr	8 yr	10 yr & over	Not mentioned
Age	Duration of Time and Number of Cases											
20-25				1	1			1				
26-30	1		1			1			1			
31-35	1		1		2							
36-40	1	1	3	1	5							
41-45	1	1	1	1	2				1			
46-50	3	1	2	1	1	1	2					
51-55	1	2	1	2	7	2	1	1		1		
56-60	3	4	4	4	4		2			1	1	
61-65	4	6	4	1	2	1	2				1	
66-70	2	2	2					1				
71-75			1									
76-80			2									
Total	17	17	22	11	24	5	7	3	2	2	2	4-116

seventy It is perhaps also worth while to point to the relatively large number of cases between thirty and forty, 11 per cent

Table II shows the duration of symptoms and again departs in no important way from the accepted views upon the subject, namely, that the symptoms in cancer are notoriously of short duration as compared with the cases of non-malignant ulcer The vast majority of these patients had symptoms for less than one year and a very considerable proportion had symptoms for six months or less

*History of Ulcer*—Some discussion might readily arise over what constitutes a history justifying the diagnosis of peptic ulcer Some observers would take the view that any history showing pain in the upper abdomen, whether or not related to food, whether or not coming in attacks, might be regarded as evidence of ulcer It has seemed to us that we were required to

## ETIOLOGY OF CANCER OF THE STOMACH

at least attempt to be a little more critical and we have regarded the phrase "a history of ulcer" as requiring us to show pain referred to the upper abdomen bearing some demonstrable relation to the taking of food and continuing over a reasonable period of time. Judged in this way there are only nine cases in this series which could be regarded as having a history of ulcer (Table III)

Of these some had a surprisingly long history, one of them extending over thirteen years, though only acute during the final twelve months. One lasted

TABLE III

*History of Previous Ulcer in 112 Cases*

Cases with History of Previous Gastric Disturbance

9—8.3 per cent of 112

Number of Cases	Duration
1	3½ years
2	4 years
2	5 years
1	7 years
1	8 years
1	10 years
1	13 years
9	

Cases without History of Previous Gastric Disturbance 103—91.7 per cent of 112

Cases in which Duration of symptoms were not mentioned 4

116

ten years, one, eight years, one, seven years, two, five years, two, four years, and one, three years and a half. Here is a group of roughly 8 per cent of our cases in which the history strongly suggested ulcer of the stomach and in which cancer was ultimately found. It is unfortunate that in this group we have only fifty-six cases in which the complete pathological study was made.

Various writers have put forward the view that the history was an important part of the evidence leading to the opinion that cancer was a relatively frequent result of ulcer. We confess that this does not appear to us logical. The short duration of the history in most cases of cancer cannot, we think, be properly held to bear any known relation to the disease itself. It is notorious that in other parts of the body at least, cancer, particularly in elderly people, is a relatively slow-growing process and it does not seem to us likely that the massive tumors which occur in some of these patients with a very short history of discomfort could have been produced in that short period. We doubt whether the duration of symptoms in the cases of cancer has any relation to the duration of the growth. It is of course possible that the symptoms are chiefly produced by surface loss of substance and that a malignant process developing in the stomach wall which does not result in loss of substance might go on for a considerable period without producing symptoms. There is another reason for skepticism in regard to the value of

so-called history of ulcer, namely, that it is not uncommon to see patients with an almost classical history of ulcer in whom no ulcer can be demonstrated to exist. It is certainly true that other conditions may produce symptoms which at least, as interpreted by the patient, would suggest ulcer. We are inclined to take the view that the history is a relatively unreliable basis for judging the relationship between ulcer and cancer.

*Location of the Growth*—Some interest attaches to the position of the growth, particularly in relation to the discussion of etiology. In our series

TABLE IV

Location of growth	Number cases	Per cent	
Pylorus	55	56.1	of 98 cases
Diffuse	16	13.8	of 114 cases
Lesser curvature	15	11.7	of 98 cases
Cardia	9	9.0	of 98 cases
Both walls	8	7.1	of 98 cases
Posterior wall	5	5.1	of 98 cases
Greater curvature	4	4.0	of 98 cases
Anterior wall	2	2.0	of 98 cases
Not mentioned	2		
	116		

sixteen cases should be excluded since the growth was so diffuse as to make it impossible to say where it had begun, and two should be excluded since location is not mentioned. Of the remaining ninety-eight, fifty-five occurred at the pylorus, fifteen upon the lesser curvature, nine at the cardiac end, eight on both walls, five upon the posterior wall, four upon the greater curvature, and two upon the anterior wall. These figures are somewhat less striking than those of many observers reporting larger series. In general, the common figures show that 60 per cent of the cases of carcinoma occur at the pylorus and about 12 per cent of the cases of ulcer, while 60 per cent of the ulcers occur upon the lesser curvature and only 12 per cent of the cases of carcinoma. In general our figures agree with other observers and tend to show that from this view there is no very striking ground for the assumption that cancer commonly or generally originates on the basis of ulcer. (Table IV.)

In our series the type of cancer is known in fifty-six cases. Of these twenty-five were adenocarcinoma, nineteen were scirrhous carcinoma, seven were mucoid carcinoma, three were medullary carcinoma and two were colloid carcinoma.

*Evidence of Preexistent Ulcer as Shown by the Pathological Report*—It may perhaps be suggested that no clinician ought to venture into the dis-

## ETIOLOGY OF CANCER OF THE STOMACH

cussion of the pathological evidence of previous ulcer and certainly any clinician so venturing takes his life in his hands. As we have already shown, opinion in regard to the frequency of ulcer as a forerunner of cancer has varied through very wide limits and this variation of opinion has occurred both among the clinicians and the pathologists. It seems to us that the question turns largely upon the criteria which are laid down as diagnostic. It is obviously possible to lay down criteria by the result of which the vast majority of cases of chronic ulcer, whether of the stomach or elsewhere, may be adjudged to be showing precancerous tendencies. MACCARTY has perhaps taken the broadest view of the evidences which should be adjudged to indicate either the presence or the imminence of cancer. He has had at his disposal an immense material and his opinions are clearly entitled to weight not only on this account, but on account of his very careful and thorough study of the subject. He has been the outstanding advocate of the view that a large proportion of cases of cancer had as their cause a preexisting ulcer. From his many contributions to this subject it is difficult to pick out excerpts which will fairly represent his criteria. The following quotation from his publication in 1909 shows his views at that time.

### Infiltration after Proliferation

In scirrhus type—fibrous tissue forms around epithelial cells which are proliferating

Cancer develops in scar tissue in some cases

Bands of scar tissue with epithelial cells included suggest early cancer

Ulcer usually exists for years before cancer develops—in a group of cases

Large ulcers with scar tissue centres and overhanging borders deep in the bases of which cancer is present, in almost every instance have originated on the lesser curvature, the usual site of gastric ulcer. Further, history of ulcer extends years back before relatively short period when history became that of cancer.

In 1910

Inflammatory hyperplasia and malignant hyperplasia are indistinguishable

Hyperplasia is forerunner of malignancy

Cancer is a malignant hyperplasia which also varies in degree, and some of the degrees so far as morphology is concerned are indistinguishable if not identical

In 1915

The epithelial cells of the glands in some ulcers lose their cuboidal or columnar shape and regularity of size and arrangement. They become oval or round and the nuclei larger and more distinct. The exact origin is unknown since in gastric glands there are not two distinct rows of cells normally present as in breast, prostate, skin, etc.

Various degrees of intraglandular morphological changes are found in the borders until the cells become indistinguishable from cancer cells. When such a condition is found, careful search frequently demonstrates a lack of demarcation between gland and stroma, and epithelial cells may be seen in the stroma, the latter condition being accepted by general pathologists to be the histological criteria of cancer.

When cancer is definitely present the intraglandular cells always present what is described as secondary hyperplasia in other organs.

In the production of this epithelial hyperplasia, there is an attempt on the part of nature to reproduce the epithelial lining of the glands. In this attempt there is failure to completely differentiate the cells with the coincidental picture of secondary hyperplasia, the cells of which differ from cancer only in position.

From these facts one may clearly see that the gastric cancer cell arises from intra-glandular hyperplastic cells of the mucosa, and represents a malignant end-stage of a process of hyperplasia of normal cells

MacCarty in 1909 gives cancer ex ulcero as 71 per cent

MacCarty in 1914 gives cancer ex ulcero as 69 per cent

HAUSER is commonly thought of as having early dealt with this question of criteria and has been much quoted in these discussions. He has the following to say on this subject

Deep, sharply cut excavation, overhanging proximal edge, firm, fibrous base and often the extension of cicatrix to surrounding organs are satisfactory evidences of the long existence of a typical peptic ulcer. The carcinoma has usually appeared at one or more points, usually distal, sometimes fused and causing induration and fixation of the edge. Outlying islands of polypoid adenoma or adenocarcinoma are not infrequently observed.

The edges are markedly hypertrophic. Cancer changes are most marked at the line of the ulcer and extend with diminishing intensity for a distance of one-half to one cm over the outlying mucosa, the infiltration involving the peripheral submucosa and muscularis, while the indurated base is free from infiltration.

EWING lays down the following criteria and also states his conclusions in regard to the relation of ulcer to cancer

1 The great majority of ulcerative lesions of the stomach fall into two classes

A Ulcerating cancers

B Simple peptic ulcers

2 In certain peptic ulcers a large part of the gastric mucosa is the seat of glandular hypertrophy with atypical changes in isolated glands and interstitial growth of connective tissue causing some derangement of glands. This is not secondary to ulcer, but may well predispose to ulcer. This may serve as a source of error in interpreting atypical overgrowth on ulcer edge.

3 Deep excavations may occur in portions of established carcinoma, especially in the pylorus, where powerful muscular contractions tend to cause hernias of the infiltrated and weakened muscle tissue.

4 Gastric digestion may strip a primary carcinoma down to muscularis or deeper, leaving no trace of carcinoma over base, but only peripheral ring of tumor tissue which is protected by mucosa.

5 When ulcer base is uniformly infiltrated with carcinoma, the condition is difficult to reconcile with an origin from the edge. Hence, great importance would seem to attach to the condition of the base of the ulcer in the diagnosis between primary and secondary carcinoma.

6 The occurrence of atypical epithelial proliferation in the glands on the edge of the ulcer is not sufficient evidence that the lesion is going on to cancer.

#### CONCLUSIONS

Carcinomatous transformation of a peptic ulcer does not exceed 5 per cent. The proportion would be smaller if only the cases were included where the evidence is demonstrable, *viz*, a long history of ulcer—the limitation of the tumor to isolated foci or one portion only of the ulcer—freedom of the base from infiltration.

SPILSBURY, 1922, has the following to say

Discusses the diagnosis of gastric ulcer under two heads

1 Destruction

2 Regeneration

At this stage there are commonly found at the edge of the ulcer, gland cells which

## ETIOLOGY OF CANCER OF THE STOMACH

have penetrated deeply into the scar tissue and are cut off from the regenerating glands. They may show a typical glandular arrangement, or may form narrow solid columns of cells. Isolated cells are also seen. It is these *cells* detached from the regenerating epithelium and buried in the fibrous tissue of the ulcer which are referred to as precancerous, and from position and irregular arrangement regarded by *others* as indicating a malignant transformation in the ulcer.

This is the Mayo criterion—not necessarily correct.

Displaced and buried epithelial cells are not peculiar to healing peptic ulcer. Found anywhere in skin or mucous membrane, ex. varicose ulcer of leg.

If cancer develops in a peptic ulcer, it must do so from actively growing and regenerating mucous membrane at the margin of a healing ulcer or from buried cells mentioned above. Such might spread from margin into tissue at base or might spread into normal stomach wall, spreads here more rapidly, hence ulcer will exhibit structure of peptic ulcer, but with a more pronounced thickening of margin on one side. There may be superficial ulceration of indurated area, growth may fungate, forming polypoid or large, soft, irregular tumors, beyond the apparent margin of the tumor separate nodules may be found in the stomach wall. On microscopic examination the bulk of the original peptic ulcer will be found to consist only of fibrous tissue and to be free from cancer. These have been encountered occasionally and described as malignant transformation in a peptic ulcer.

Processes of irregular regeneration mistaken for malignant transformation by many.

Estimate from above criteria (same as Ewing) certainly not more than 5 per cent of peptic ulcers of the stomach, probably not more than 1 to 2 per cent develop secondary malignant disease.

When dense fibrous tissue of base is infiltrated everywhere with cancer cells regard such a tumor as a primary cancer with secondary ulceration.

Malignant transformation of a peptic ulcer must be an uncommon event.

At our request PROFESSOR A. S. WARREN has set down for us the following as the criteria which influence him in coming to an opinion.

*Criteria for diagnosis of carcinoma arising in a chronic peptic ulcer.* There must be convincing evidence of the existence of an older ulcer in the presence of an induration or cicatricial fibrosis extending through the stomach wall with characteristic sclerosis of the blood-vessels—the greater part of this cicatrix being entirely free from carcinomatous infiltration—the latter being limited to the borders or surface of the ulcer—the carcinoma must be a relatively early development, infiltrating the ulcer-scar to but a slight extent so that there can be no doubt that the fibrosis is the result of the healing of an older ulcerative process and not secondary to the carcinoma. If the induration is the result of a primary carcinomatous ulcer, it will be infiltrated throughout with cancer-cell nests. It is important, however, that no errors be made in the interpretation of regenerative gland-formations and proliferations at the sides or base of an ulcer. These have undoubtedly been mistaken by some pathologists for evidences of malignancy. No diagnosis of cancerous or pre-cancerous states can be made from the characteristics of individual cells of such regenerative conditions, either in size, form or staining qualities of nuclei or cytoplasm. The diagnosis of carcinoma depends wholly upon the presence of free-growing cells in the tissue-spaces, infiltrating the scar tissue, producing a secondary inflammatory reaction in the latter and presenting the appearances of mature cancer nests and not connected (in serial sections) with the normal glands at the border of the ulcer. In serial sections the continuity of regenerative proliferations with the bordering epithelium can always be demonstrated, in the cancer no continuity between normal gland epithelium and the carcinoma can be shown. A destructive infiltration of the mucosa at the border of the ulcer with cords and masses of epithelial cells more or less atypical growing without relationship to a basement membrane, should be interpreted as carcinoma.



FIG 5—Case I 1329 4 J G Scirrhous ( signet ring celled) carcinoma infiltrating mucosa at border of chronic peptic ulcer



FIG 6—Case I 1329 7 J G Small celled ( signet-ring scirrhous) carcinomatous infiltration of base of chronic peptic ulcer near border

## ETIOLOGY OF CANCER OF THE STOMACH

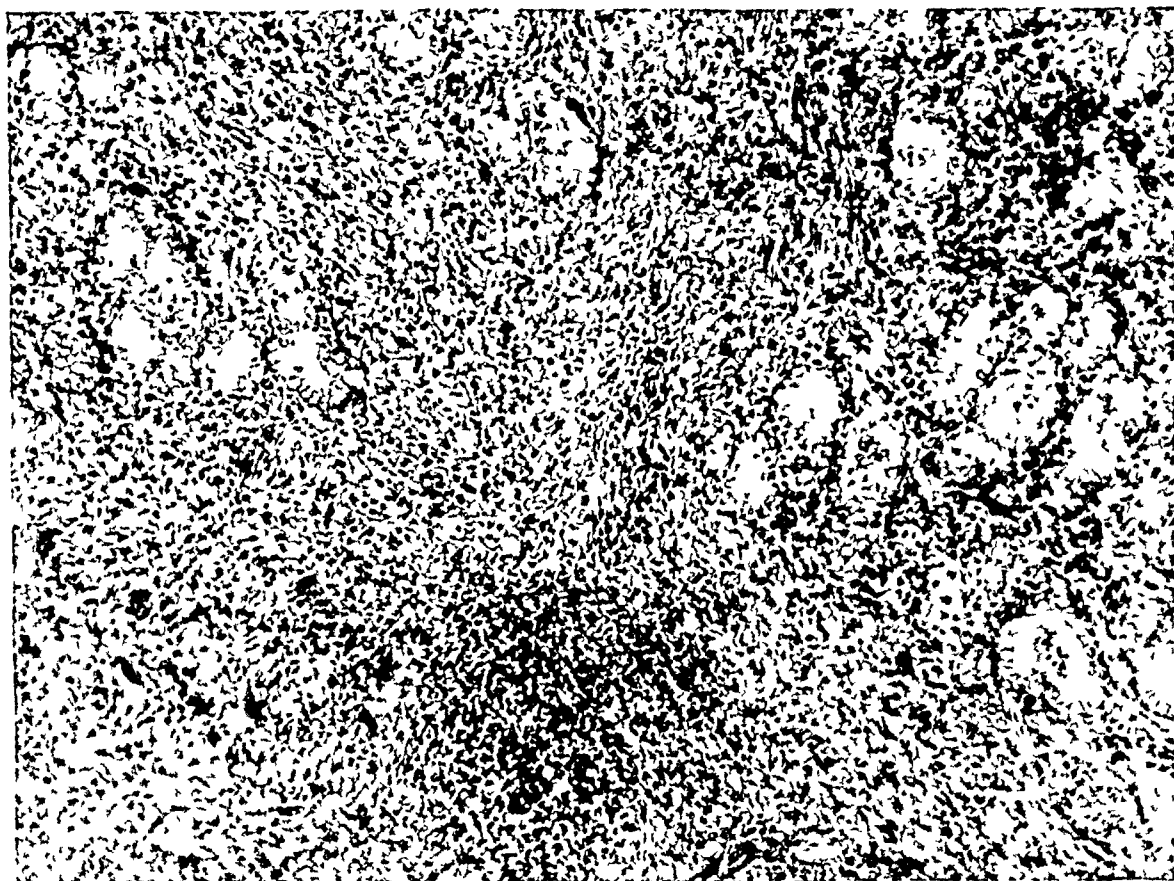


FIG. 7—Case I 1320-7, J. G. 'Signet-ring' scirrhous carcinomatous infiltration of mucosa near border of chronic peptic ulcer. Remains of older glands showing mucoid degeneration.



FIG. 8—Case II 1607-AA C. C. Edge of chronic peptic ulcer with carcinoma developing on one side of ulcer. Infiltration of border of ulcer with malignant carcinoma cells, some showing signet-ring mucoid degeneration. Carcinoma arising in a primary peptic ulcer.





FIG. 9.—Case II 1607-AA C. C. Base of ulcer near carcinomatous border showing cords of small round carcinoma cells infiltrating scar tissue. Carcinoma arising in primary ulcer.

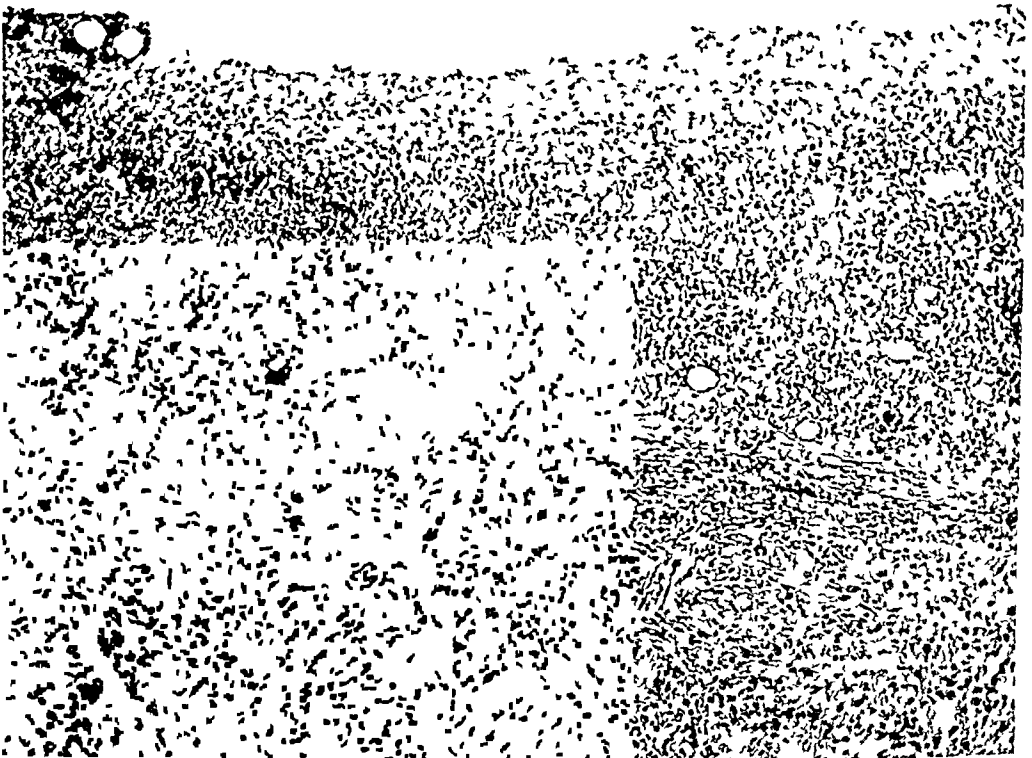


FIG. 10.—Case II 1607-AA C. C. Base of centre of ulcer above exudate on floor of ulcer, below scar tissue infiltrated with plasma-cells lymphocytes and leucocytes. No carcinoma cells.

# ETIOLOGY OF CANCER OF THE STOMACH

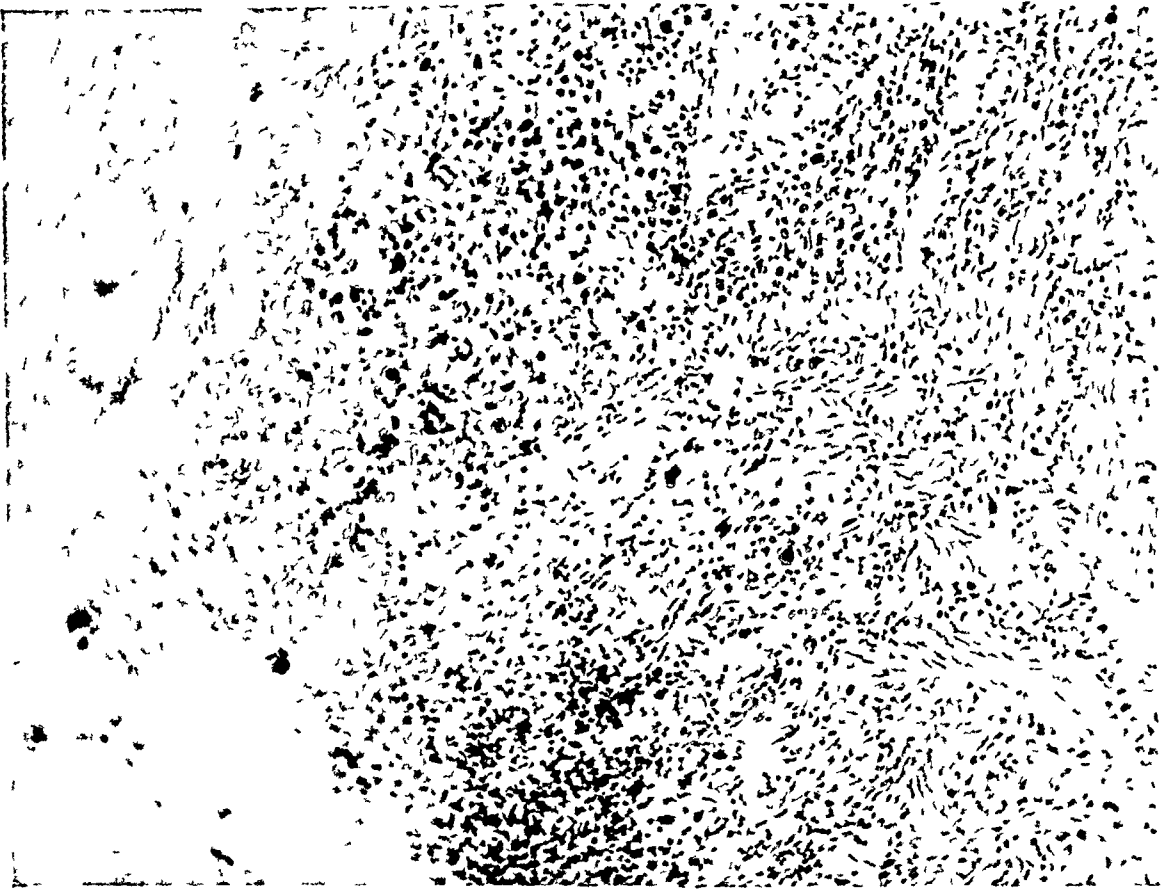


FIG. 11—Case III, A-116-AB, V B Scurrhous carcinoma at border of older gastric ulcer

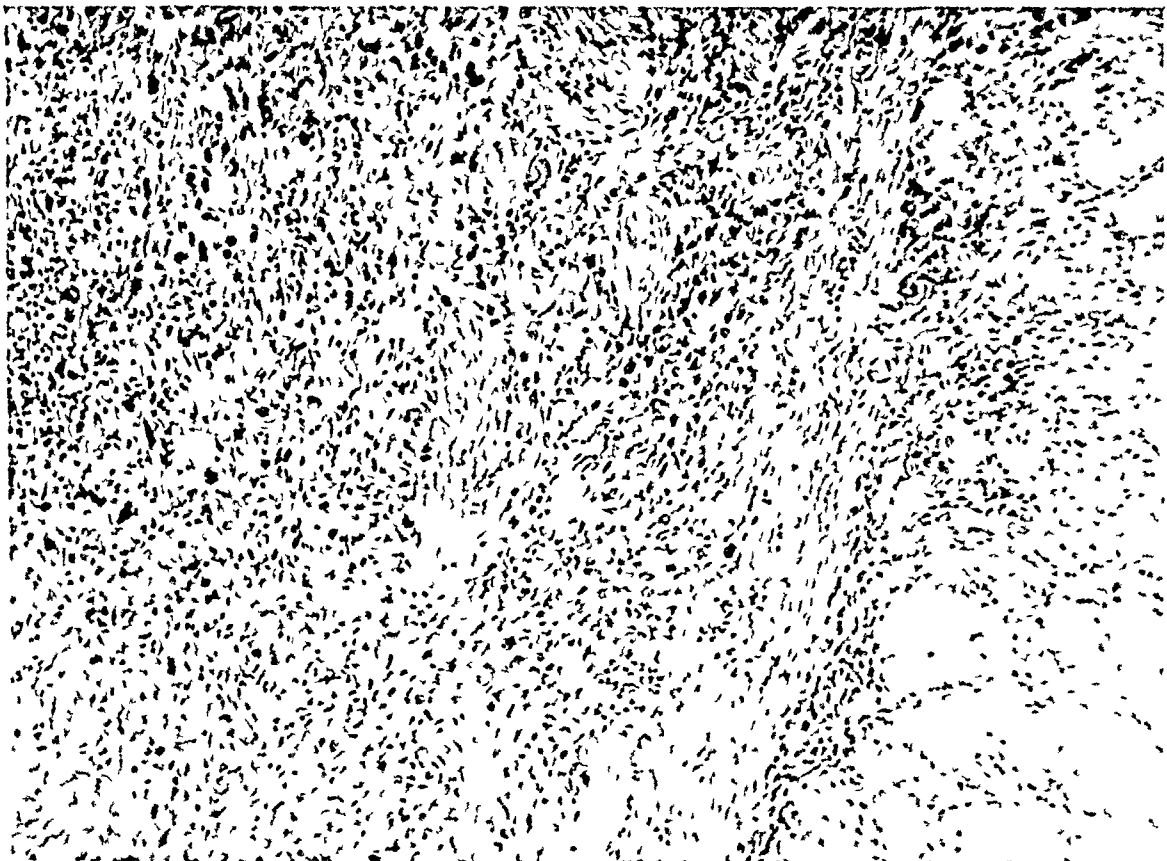


FIG. 12—Case III, A-116-AB, V B Scurrhous carcinoma infiltrating the submucosa of older ulcer

Of the cases in our series there are fifty-six in which the whole region was at the disposal of the pathologist. We have not included cases in which only a portion of the specimen was available, since it might easily be suggested that some other portion not at the disposal of the pathologist might have shown evidence of cancer. In this group there are five cases in which there is clear evidence of both peptic ulcer and cancer and using the criteria laid down above, Professor Warthin has come to the conclusion that they are true instances of cancer developing secondary to chronic ulcer. This would appear to require the admission that cancer is a definite result of ulcer in a certain proportion of cases.

The following is a brief abstract of these cases.

CASE I—J. G., male, fifty-seven. No history of previous ulcer. Duration of symptoms, two months. Loss of weight, twenty pounds. Palpable mass in epigastrium. Operation. Partial gastrectomy. Pathological report. Scirrhus carcinoma of the stomach. Chronic peptic ulcer. Base of ulcer shows no carcinomatous infiltration, but the stomach wall and the borders do.

CASE II—C. C., male, forty. No history of previous ulcer. Doubtful loss of weight. Partial gastrectomy. Pathological report. Very severe chronic hyperplastic catarrh. Two small subacute ulcers with a little island of preserved mucosa between them. These are relatively recent. The induration is still quite cellular and extending only to the muscles. The mucous membrane on one side is very atypical. The gland cells are small and infiltrate the stroma and in one place extending through the mucosa. Early scirrhus carcinoma. In the other side of the ulcer there is also a group of carcinoma cells showing mucoid degeneration with signet-ring cells. The ulcer here has involved the carcinoma. There is no deep infiltration of the wall and this is about as early a stomach cancer as we have ever seen.

CASE III—V. B., male, fifty-five. Entered on account of abdominal pain. Eighteen months' duration. No previous history suggesting ulcer. Loss of weight, twenty-five pounds. Operation. Partial gastrectomy. Pathological report. On the lesser curvature just above the pyloric opening on the posterior wall of the stomach there is an ulcer 8 cm. long by 4 cm. wide with definite borders. The floor is irregular and at its lowest part there is a feeling of induration imparted to the examining finger. Edges appeared firmer in consistency than the floor. The depth of the ulcer is 5 mm. No induration or infiltration outside of it. Numerous small enlarged glands found along the greater curvature. Decided feeling of infiltration around the pyloric orifice. Microscopic examination. Old chronic peptic ulcer of large size. Marked fibroid. Induration at base. At border of ulcer is large area of scirrhus carcinoma infiltrating the mucosa and submucosa and into the muscular coats. No carcinoma at base or at other border. A carcinoma developing at the border of a chronic peptic ulcer. Mucosa shows chronic catarrhal gastritis. Lymphatic glands show atrophy and chronic passive congestion. Edema. Early metastasis of carcinoma.

CASE IV—W. C. G. The three photomicrographs shown below demonstrate the mistake that might be made in diagnosing carcinoma arising from chronic gastric ulcer.

CASE V—J. J. V., male, thirty-nine. Enters on account of abdominal pain. No previous history of ulcer. Duration of symptoms twelve months. Loss of weight, twenty-five pounds. Operation. Partial gastrectomy. Pathological report. Chronic catarrhal gastritis. Large chronic peptic ulcer with dense inflammatory base. At the margin of the ulcer there is an adenocarcinoma which in its older portions shows the structure of an adenocarcinoma mucosum. This is apparently another example of the development of a carcinoma near the margin of a chronic ulcer. Two small lymph-nodes show no metastasis. The carcinoma is so well advanced, however, that we believe metastasis has probably taken place.

## ETIOLOGY OF CANCER OF THE STOMACH

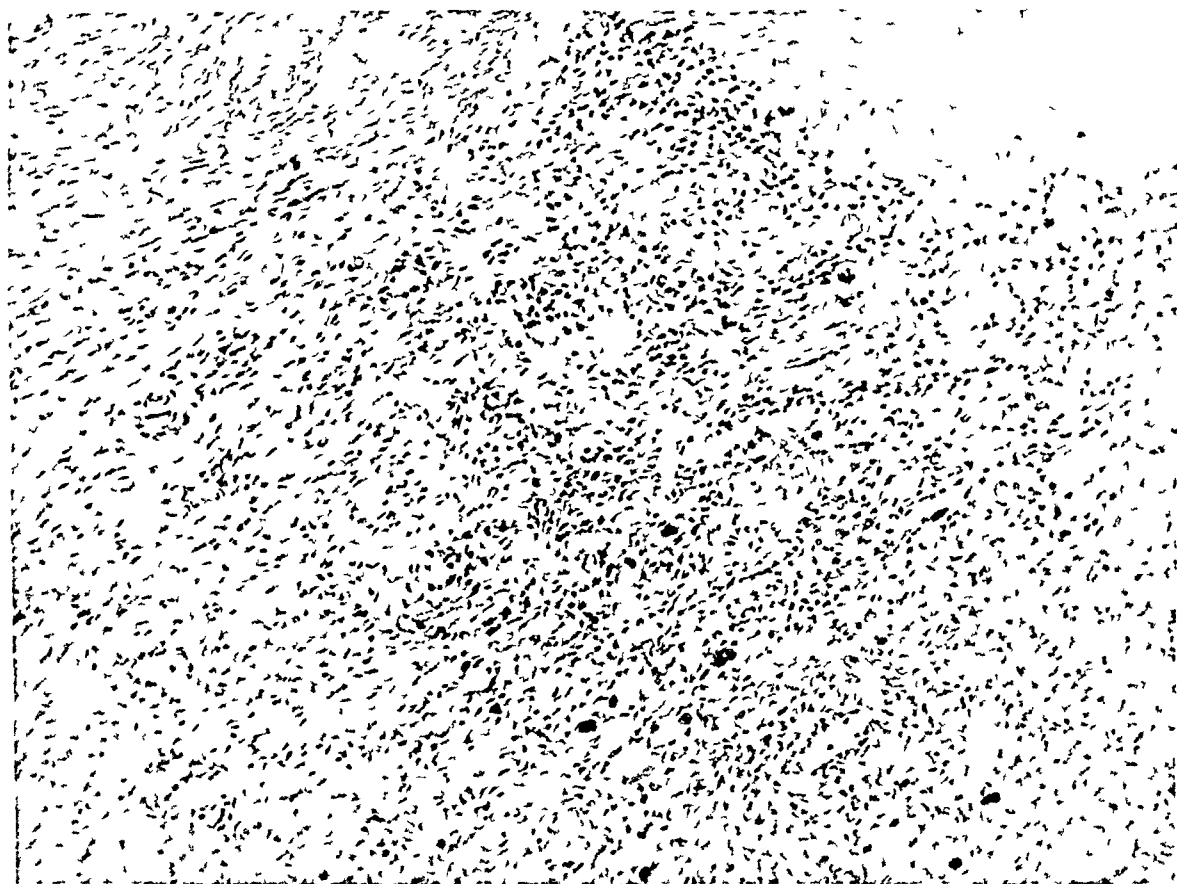


FIG. 13.—Case III A-116-AB V B. Scirrhus carcinoma infiltrating cicatricial tissue of floor of ulcer at one border of the older ulcer. Carcinoma secondary to ulcer.

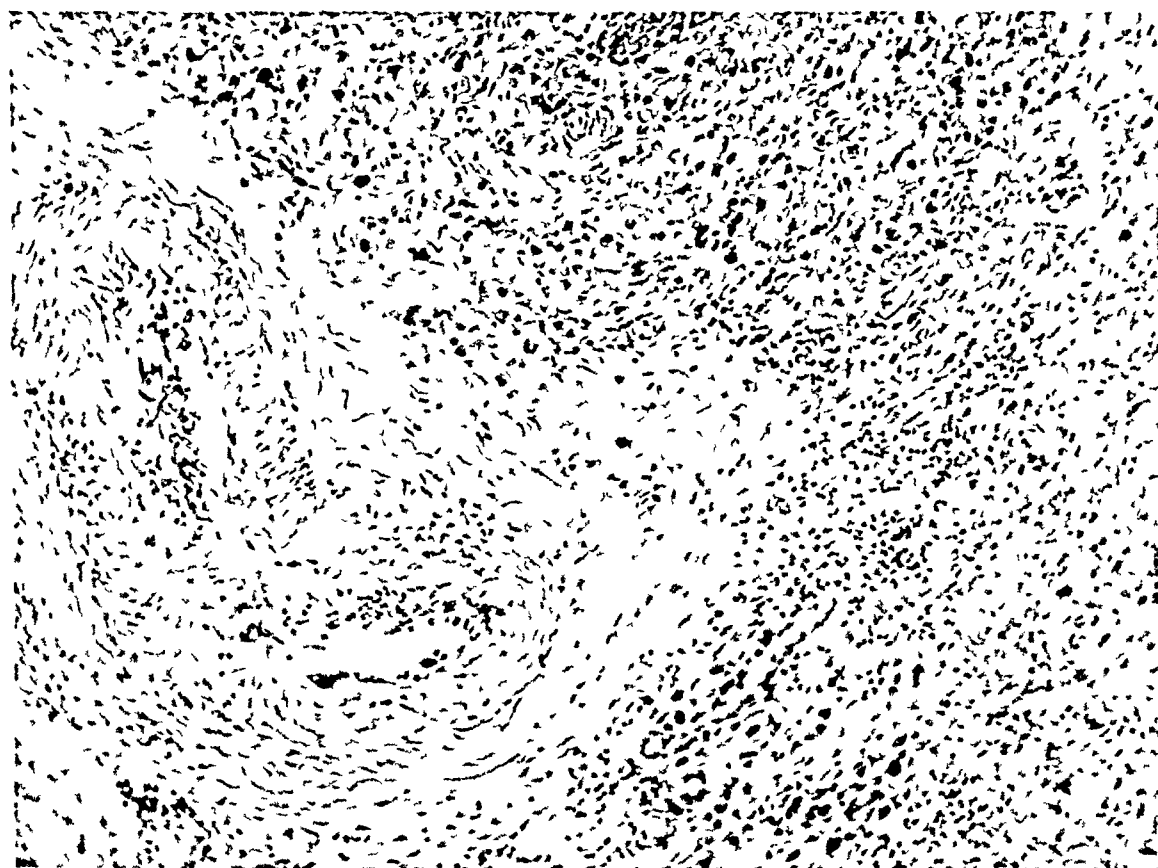


FIG. 14.—Case III A-116-AB V B. Scirrhus carcinoma infiltration of submucosa border of chronic peptic ulcer. Carcinoma arising in older ulcer and infiltrating floor and border of ulcer.

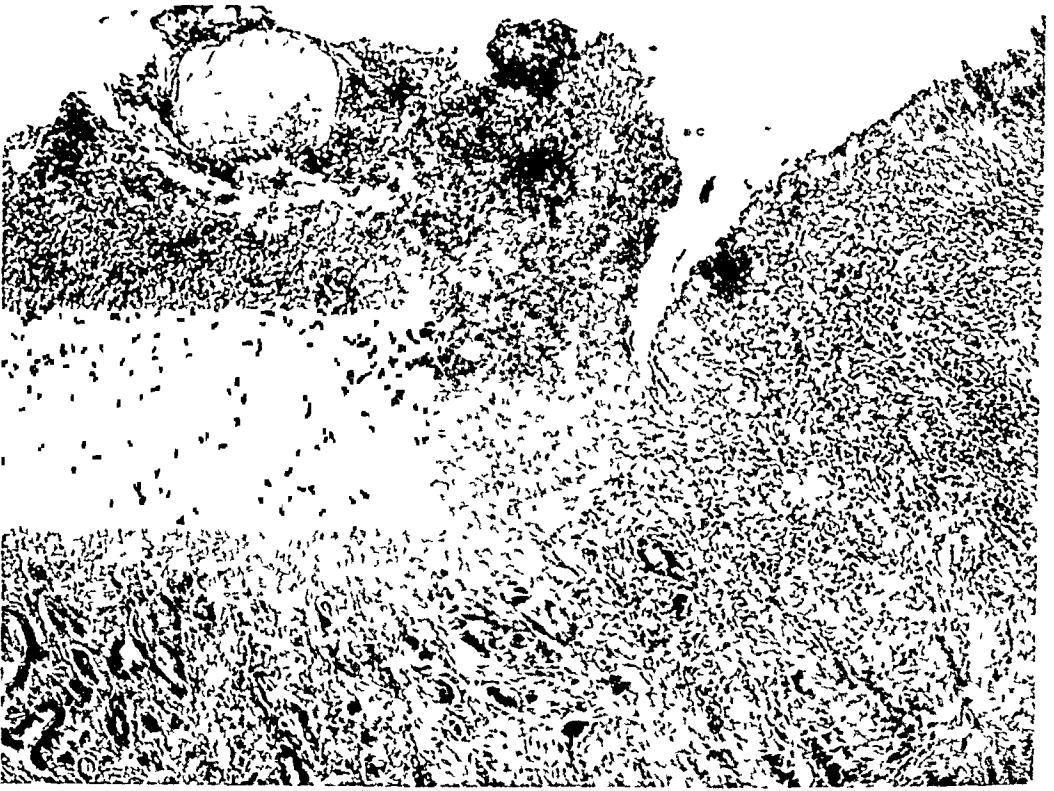


FIG 15—Case IV 2530-AB W C G Low-power view of ulcerating adenocarcinoma Ulcer is primarily carcinomatous

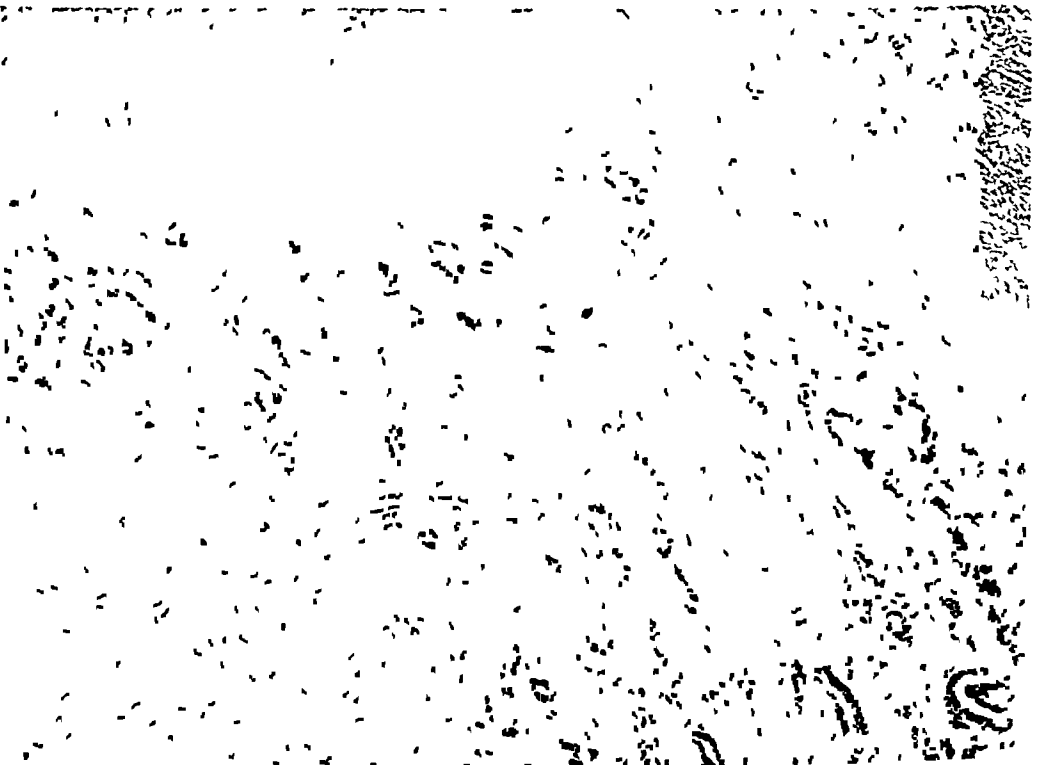


FIG 16—Case IV 2530-AB W C G Floor of ulcer near opposite border from that seen in preceding adenocarcinomatous infiltration Primary ulcerating adenocarcinoma

## ETIOLOGY OF CANCER OF THE STOMACH

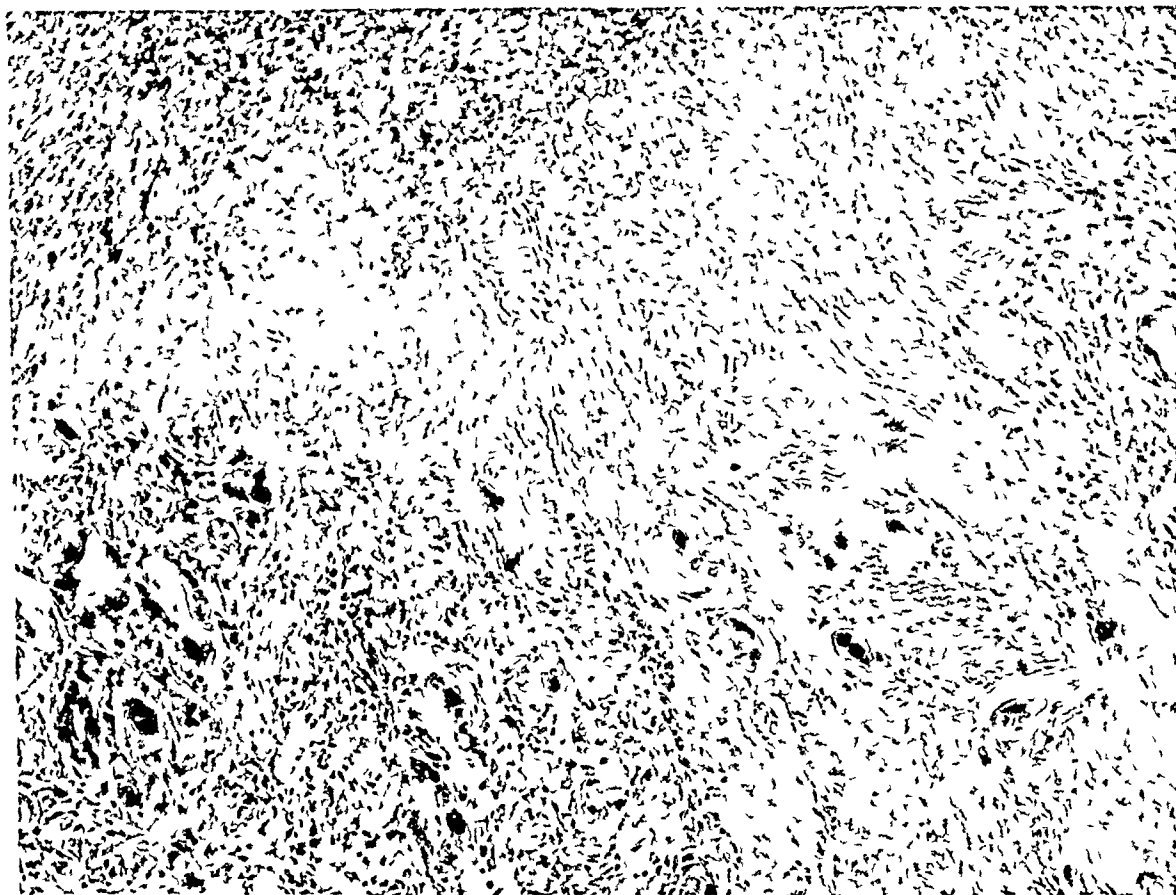


FIG. 17.—Case IV, 2530-AB W. C. G. High-power view of preceding adenocarcinomatous ulcer.



FIG. 18.—Case V, 466-AB I. J. V. Edge of chronic gastric ulcer. Adenocarcinoma border. Atypical hyperchromatic gland tissue infiltrating border of ulcer. Floor of ulcer shows adenocarcinoma. Primary adenocarcinoma developing in border of chronic ulcer.

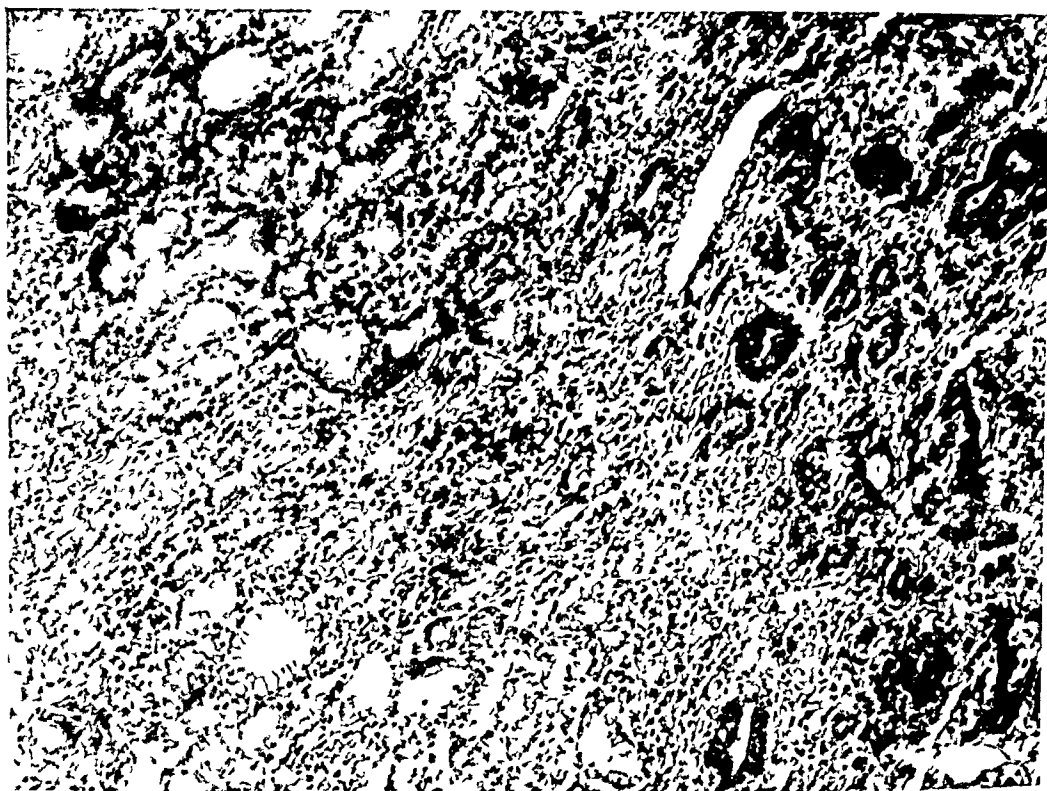


FIG 19—Case V, 4266-AB J J V Border of same ulcer as in preceding a little farther from the ulcer showing adenocarcinomatous infiltration of mucosa



FIG 20—Case V 4266-AB J J V Adenocarcinomatous infiltration of muscularis at border of chronic ulcer Carcinoma arising at border of ulcer

## ETIOLOGY OF CANCER OF THE STOMACH

CASE VI—W H S, male, seventy Several years of indigestion Possible ulcer history Acute pain two months Loss of weight, ten pounds Operation Partial gastrectomy Pathological report A scirrhus carcinoma arising from scar of old peptic ulcer The carcinoma is rather superficial in the mucosa, but shows some infiltration into the submucosa and muscularis The greater part of the induration due to the old chronic ulcer

In some of the literature on the subject there appears to be confusion as to precisely what is being discussed The most important question at issue appears to us to be not the proportion of cases of cancer in which ulcer has previously existed, and to which the cancer may be adjudged to be secondary, but what proportion of cases of chronic peptic ulcer of the stomach are likely to show malignant changes after a term of years Now obviously the proportion of cases of cancer showing evidence of previous ulcer bears no relation to the whole number of cases of ulcer upon which cancer ultimately develops This is a very difficult subject upon which to get convincing evidence The best evidence obviously would be a collection of a large number of cases of demonstrated ulcer which after a term of years were known with equal certainty to have developed cancer The literature on this point is not large and the relatively small number of cases which have been reported throws little light upon the proportion

### BIBLIOGRAPHY

- Aaron, C D "Diseases of the Digestive Organs," 1921  
 Anschutz *Verhand d Deut Gesell f Chir*, 1912  
 Anschutz *Deut Zeit f Chir*, 1920  
 Aschoff, Von L *Deut Med Wochenschrift* vol XXXIII, 1912  
 Billeter, A *Beitrage f klin Chir*, vol IX, 1914  
 Cruveilhier *Anatomie pathologique du Corps humain*, 1835-1842  
 Deaver and Reimann *Surg, Gyn and Obst*, vol XXXII, 1921  
 Deaver, J B *Ill Med Jour*, Dec, 1922  
 De Quervain, F *Surg, Gyn and Obst*, Jan, 1922  
 Dible, J H *Brit Jour Surg*, April, 1925  
 Dittrich *Vierteljahrs-schr f d Prakt Heilkunde Prag*, 1848  
 Duplant *De la pretendue transformation de l'ulcere rond en cancer* Theses, Lyon 1898  
 Ewing, J *ANNALS OF SURGERY*, vol LXVII, 1918  
 Exalto, J *Archiv f klin Chir*, vol CX, 1918  
 Fenwick, S "Ulcer of the Stomach and Duodenum"  
 Finsterer, H *Archiv f klin Chir* Sept, 1924  
 Friedenwald, J *Amer Jour Med Sc*, 1914  
 Friedlander *Über Epithelwucherung und Krebs* 1877  
 Gruber, G B *Zeitschr f Krebsforschung* vol XIII 1913  
 Hauser *Das chr Magengeschwul* Leipzig 1883  
 Hauser *Munch Med Woch*, 1910  
 Heitler *Wien med Wochenschr* 1883  
 Hirschfeld, F *Verhandlung d Congress f Innere Med* 1902  
 Jones, C R *Med Jour and Record* Feb 1924  
 Konjetzny, G E *Beitrage f klin Chir* vol LXXX 1913  
 Kuttner *Archiv f klin Chir* S 412 1910  
 Lockwood, G R *Jour A M A* April 1911  
 MacCarty, W C *Surg Gyn and Obst* May 1910  
 MacCarty, W C *Amer Jour Med Sc* April 1915



# CABOT AND ADIE

- Mayo-Robson, A W Lancet Dec, 1904
- Mayo-Robson, A W Med Clin Trans, vol xc p 232
- McDowell, I W Papers from Mayo Foundation, 1919
- Meyer, Carl Berlin 1874 (cit Duplant)
- Morley, J Lancet, Oct, 1923
- Moymhan B G A Clin Soc Trans vol xxxix 1906
- Moymhan B G A Brit Med Jour April 1909
- Murphy, J B Clin of J B Murphy, April 1914
- Nielsen, N A Acta Chir Scandinavica vol lv, 1922-1923
- Ochsner, A J Jour A M A Sept 1915
- Paterson H J 'The Surgery of the Stomach' p 276
- Pauchet et Hirschberg Bull de L'Academie de Med, Jan 1924
- Pavr, E Archiv f klin Chir vol xciii, 1910
- Peyser F Deut Zeit f Chir, 1921-1922
- Rodman W L Trans Amer Surg Assn vol xxxi, 1908
- Rodman, W L Jour A M A, vol l 1908
- Rokitansky C Handb d spec path Anat 1842
- Rutimver L Spezielle Path vol v 1921
- Sherren J Brit Med Jour June, 1911
- Smithies F Ill Med Jour Jun 1917
- Spilsbury B H Proceedings Royal Soc Med, Oct 1922
- Taylor and Miller Amer Jour Med Sc 1921
- Trippier Semaine Medic, 1898, p 241
- Walton, A J 'The Surgical Dyspepsia' p 221
- White W H Brit Med Jour April, 1909
- Wilensky A O ANNALS OF SURGERY, vol lxxiii 1921
- Wilson and MacCarty Amer Jour Med Sc Dec 1909
- Wollman Beitrage z Kennt d chi Magengeschwur Berlin 1868 S 28

## PAPILLOMATA OF THE LARGE BOWEL

BY VERNON C. DAVID, M.D.

OF CHICAGO, ILL.

WHILE the incidence of benign adenomata and papillomata of the large bowel is not great, they occur more frequently than any of the other benign tumors. There has been a rather sharp distinction drawn between the clinical and histological characteristics of adenomata and papillomata of the large bowel. Adenomata, found most often in childhood, also occur in adults as pedunculated mucous covered polyps with a smooth or finely lobulated surface. Occasionally they are found in the sigmoid as single tumors and reach a size sufficient to partially occlude the lumen of the bowel or become the apex of an intussusception. A condition of multiple polyposis is occasionally observed where hundreds of adenomata of varying size and attachment involve the whole large bowel. This condition has been well described in literature and the dangerous anemia and tendency to malignant degeneration of the tumors have been emphasized. In addition to true adenomatous polyps inflammatory polyps may develop in the base of amebic ulceration or in hyperplastic tuberculous ulceration of the large bowel. These inflammatory polyps resemble neoplastic adenomata both in form and attachment, but may be differentiated by microscopic examination.

*Incidence of Papillomata*—Papillomata or villous tumors of the large bowel have been described in occasional reports and are mentioned briefly in text-books.<sup>1</sup> A scarcity of the literature on the subject is no doubt in part due to the fact that no one observer has been privileged to observe a large number of instances of papillomata of the large bowel. Rotter<sup>2</sup> and Goebel<sup>3</sup> in the German literature, and Quenu and Landel<sup>4</sup> in the French literature have critically considered these tumors especially as to their potential malignancy. Allingham in his text-book of 1882, mentions fourteen cases including those observed by Quam, who is credited with having first called attention to this type of tumor in the literature. Goebel in 1913, collected seventeen cases described in the literature in addition to the forty that Rotter had reported. Since 1913 in a rather careful search, only six additional case reports were encountered. Undoubtedly other papillomata of the large bowel have been observed, but no record of them has been made.

While it is evident that papillomata of the large bowel are not common they are nevertheless of importance from a diagnostic and surgical pathological point of view, due to their position in tumor classification as a pre-cancerous lesion.

*Symptomatology and Diagnosis*—These tumors are almost exclusively found in adults. If the papilloma occurs in the rectum bleeding of bright red blood at the time of bowel movement is the most prominent symptom. It

---

\* Read before the American Surgical Association May 4, 1925.

this bleeding persists unchecked a secondary anæmia supervenes In one patient observed the hæmoglobin dropped to 28 per cent The bleeding, which may take on the character of a hemorrhage at times is not accompanied by the presence of pus in the stool, and this is a characteristic difference from carcinoma of the bowel If the tumor is attached low in the rectum, it may prolapse and be reduced with more or less difficulty A true prolapse of the rectum may be induced by the tumor which occupies the apex of the prolapsed bowel Due to the large secreting surface of the tumor, a great amount of mucous is formed which may be passed at bowel movement or find its way out on the skin by leakage through the sphincter muscles

If the papilloma occurs at the recto-sigmoid junction or higher in the large bowel, the bleeding is more likely to be intermittent and come in

attacks This is probably due to the lessened mechanical irritation of the soft tumor mass by contents of the bowel If the papilloma reaches considerable size, constipation develops and a

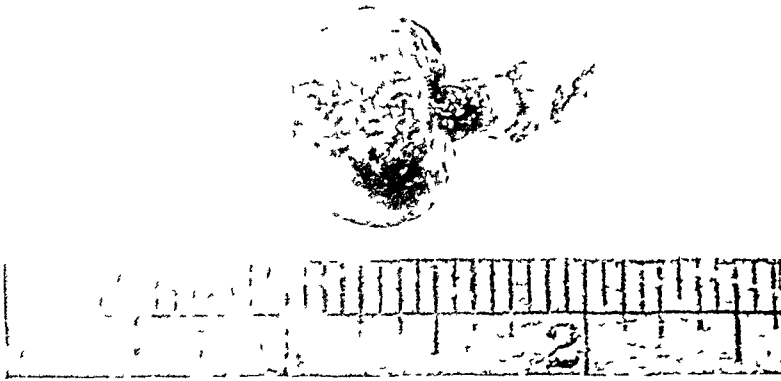


FIG 1—Simple pedunculated adenoma of the rectum from a male aged twenty five years

filling defect of the large bowel is seen which looks much like the filling defect in an early carcinoma of the colon (Fig 4)

The course of these papillomata may include several years with long periods of freedom from symptoms The general health of the patient may be but little impaired Pain is usually absent These considerations are important in a differential diagnosis from cancer of the bowel At the conclusion of the article, case reports will be given illustrating these points

*Pathology*—Papillomata of the rectum and colon correspond very closely in the gross appearance and morphology to papillomata that occur more commonly in the bladder and larynx Their color, attachment, multiplicity, occasional tendency to recurrence and microscopic appearance, as well as the general tendency to become malignant holds about equally for the papilloma appearing in these different regions

Papillomata occurring in the rectum are lobulated or villous tumors varying in size from a pea-like nodule to a tumor the size of a child's head, as reported by Allingham They usually have a sessile broad attachment on the mucosa which may be multiple with more or less normal appearing mucosa between the several points of attachment These tumors rarely are pedunculated They may have a surface of wavy villous prolongations that float in water The surface of the tumor, on the other hand, may be coarsely

nodular as those that occur in the bladder and larynx, but still have a typical papillary structure microscopically. The tumor often has several lobes which in turn are divided into many small lobules (Figs 8-11). The color of the papilloma is red and frequently clots of blood are seen adhering to the surface that has most recently bled. In consistency the tumor is characteristically soft and sponge-like and has no induration at its base or attachment. Multiple papillomata of the large bowel have been observed where the bleeding has been so great as to be serious. When this condition occurs above the reach of the examining finger the differentiation from a malignant growth is difficult to make.

Higher in the large bowel, papillomata are not commonly found. In the instance quoted as Case I, the tumor mass in the descending colon was so soft it could only be palpated with difficulty in



FIG. 2.—Simple pedunculated adenoma of the rectum from male aged fifty years. Shows rich connective tissue stroma containing fluid (cystic dilatation). At lowest portion of picture columnar epithelium covering the surface of the tumor.

the unopened bowel at the time of operation. It had a broad attachment to the mucosa and encircled the bowel with the exception of a small area opposite the mesenteric attachment. When the bowel was opened the tumor had a soft papillary structure without induration with a raised margin which made a definite line of demarcation from the normal mucosa of the bowel. There was no ulceration over the tumor mass. Sections of this tumor are seen in Figs. 5, 6 and 7.

The tendency to recurrence after removal of papillomata of the large bowel does not seem as great as in bladder or laryngeal papilloma. It may be that the thoroughness of removal of the tumor mass can be better guaranteed in the rectum. On the other hand several instances have been recorded

where recurrence has taken place several times after operative removal of papilloma of the rectum. Recurrence of the tumor in other locations in the bowel is also possible. In Case II several small papillomata appeared on the mucosa of the colostomized bowel where the colostomy was done to decrease the bleeding in a nearly exsanguinated patient who had multiple papillomata in the ampulla of the rectum. The structure of these new tumors is shown in Fig 12.

The microscopic appearance of these papillomata of the large bowel varies in some degree dependent on their attachment to the mucosa of the bowel.



FIG 3—Pedunculated adenoma of the rectum with marked inflammatory exudate from a child aged three years. Only epithelial element found in many sections shown at A.

In the pedunculated papillomata there is found a marked connective-tissue framework containing blood-vessels, fibroblasts, some muscle cells wandering cells of different types and round-cell accumulations of varying degree. In this connective-tissue pedicle no granulation tissue is seen. The

connective-tissue stroma branches and rebranches to the finest ramification of the papillary outgrowths at the periphery of the tumor. Near the base of attachment the epithelium takes on a more or less glandular appearance with acinus formation. Some of the glands are dilated the epithelium is low and small nuclei are present in the base of the cells. Cyst formation is occasionally seen (Figs 9 and 10, Case V). Farther to the periphery of the tumor the epithelium takes on a different character in that the cells are columnar with rather clear protoplasm with elongated basal nuclei. There are usually many goblet cells to be seen. In the papillary projections of the tumor the epithelium is higher the nuclei are usually multiple, are inclined to be hyper-

chromatic and mitoses are not infrequently seen. The basement membrane however, is everywhere intact and except at the periphery of the tumor the muscularis mucosa is easily seen and is intact.

In the more common type of papillomata where the attachment is sessile the papillary structure of the tumor seems to spring from the mucosa of the bowel and the papillary projections take the place of the normal mucosa. Here and there, immature connective-tissue pedicles run into the mass, making a fine reticular stroma containing blood-vessels, fibroblasts, and wandering cells. The adenomatous feature of the mucosa is more in the background, but the character of the epithelium covering the papillary projections correspond to the description given for the pedunculated type.

The relation of adenomata of the bowel to papillomata seems to be very close. Not only are simple adenomatous structures found in most papillomata, but characteristic cystic degeneration of the adenomatous structure is also observed (Fig. 10). Some tumors have been observed where certain portions are wholly adenomatous and other portions of the same tumor take a papillomatous structure (Fig. 13). Grossly, adenoma which are usually pedunculated (Fig. 1) may have a smooth surface or may be finely lobulated like papilloma, in which event it is difficult to foretell the exact microscopic picture. Inflammatory polyps having the appearance of pedunculated adenoma may arise from the chronic ulcerative processes in the large bowel, which microscopically have no epithelial covering and consist of granulation tissue and fibroblasts along with a rich cellular exudate. Pedunculated adenoma are observed where microscopically the adenomatous structure is almost entirely lost and in which the products of inflammation are the predominant picture (Fig. 3). These varying clinical and microscopic pictures suggest very strongly the possible influence of inflammation in the formation of this class of tumors in the large bowel. In this connection it should be stated that Doctors Belleh and Milton<sup>1</sup> have reported finding *Bilharzia Hamatobia* in adenomata of the rectum. Ball cites a case where the ova of the *Oxyuris vermicularis* were found in the substance of a papillomatous tumor of the bowel.

*Relation of Papillomata of the Large Bowel to Carcinoma*—The consideration of these tumors as potentially malignant or as pre-cancerous growths offers a chance for considerable speculation.

Queny and Landel, who wrote the first important monograph on these tumors state that they are all types of "epitheliome cylindriques" and correspond to the slowly growing epithelioma of the face in old people. They base their contention on the fact that at the periphery of the papillary structures the cells have multiple hyperchromatic deeply staining nuclei with few goblet cells and correspond to the cells seen in papillary cancer of the rectum.

Goebel states that the malignancy does not take place in the periphery of the tumor but at the base and describes very carefully two cases which had the appearance of benign papillomata of the rectum but which on

microscopic examination revealed the basement membrane broken and penetrated by epithelial elements invading the submucosa in one small portion of the tumor. He collected 57 cases from the literature up to 1914, of which he believes 8 were malignant, including both of his own. He states all papillomata of the large bowel should be regarded with suspicion as to their malignancy.

Mummary, in his text-book of 1923, reported one case of papillomata of

the rectum and sigmoid and states that all adenomata of the large bowel eventually take on a malignant change (Fig 14)

Practically all writers on this subject regard papillomata of the large bowel with more or less suspicion as to their pre-cancerous nature. Some regard every such tumor as one which if not malignant at the time of

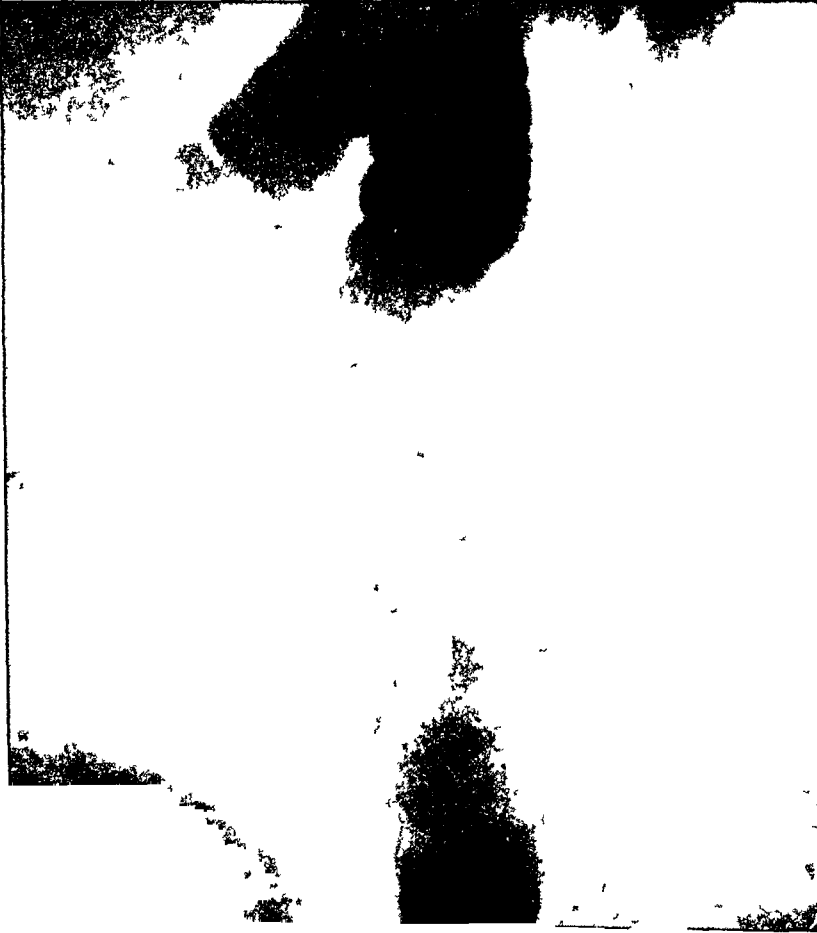


FIG 4 —Case I Filling defect due to papilloma of descending colon

examination will eventually become so. Others simply speak of these tumors as potentially malignant.

It has been possible for us to study nine tumors of the large bowel which we believe should be classified as papillomata or adeno-papillomata. Eight of these patients were examined by us or were under our care, so that a history of the lesion, numerous clinical examinations of the tumor *in situ*, as well as the material for histological study, were available for diagnostic purposes. Histological study alone was possible in one additional tumor of this type. Appended to the article are the histories and results of histological examination of the tumors, as well as the treatment employed. The question of the malignancy or pre-cancerous nature of these tumors was constantly in mind.

## PAPILLOMATA OF THE LARGE BOWEL

While deeply staining hyper-chromatic nuclei undergoing occasional mitosis are findings in a benign tumor that are suspicious of malignancy, they are changes not uncommonly found in rapidly growing epithelial tumors. While such microscopic changes are not to be neglected in weighing the evidence as to the malignancy of the tumor, it seems of much greater importance to observe the regular arrangement and form of the epithelial cells on the basement membrane which everywhere presents an unbroken continuity in a benign tumor. In other words, the infiltrative character of the tumor is of the greatest significance in the microscopic study of a malignant tumor (Figs 14-17). Coupled with this, and of almost equal importance, is the gross pathological appearance and "feel" of the tumor as well as the clinical history of its growth. These are the criteria we have used in the diagnosis of the benignancy or malignancy of the tumor. Small pieces of these tumors are not sufficient in themselves to allow proper histological study to be made but sections must be studied which run through the base of the tumor and its attachments.



FIG. 5.—Case I. Twelve diameter magnification of section from papilloma of descending colon shows tumor taking place of normal mucosa. In one area delicate pedicle formation.

In considering our cases the clinical suspicion of malignancy was always enhanced where the tumor was high in the rectum or large bowel and was therefore not accessible to palpation or to the helpful "feel" of the tumor mass. In this type of tumor the lesion was usually of longer standing. The anemia of the patient was more marked and the filling defect on fluoroscopy made the diagnosis of carcinoma most probable. In Cases I and II the above findings were all present and the presumptive diagnosis of malignancy was made. In Case I where the filling defect (Fig. 4) was just below the splenic flexure it was barely possible to feel a difference in consistency in that portion of the bowel occupied by the tumor as compared to portions of the bowel above and below it. The tumor-bearing portion of the bowel was resected in this patient by a three-stage Mikulicz procedure and a papilloma nearly



encircling the bowel attached by a broad base on the side of the mesenteric attachment was found. Many sections of this tumor (Figs 5, 6 and 7) show its benign character. The tumor is formed by elongation of the mucous membrane into papillary structures although a slight degree of adenomatous changes are found in some areas (Fig 5).

With some minor variations the history and findings in one other tumor in this location presented the same picture and no evidence of malignancy was found (Case II).



FIG 6—Case I. Magnification sixty diameters shows small area of adenomatous acini next to base of papillary projections. Intact muscularis mucosa.

Another patient (Case III), with a tumor in the ampulla of the rectum which had a broad attachment and no evidence of deep fixation of tumor to bowel wall, presents clinical history and appearance of a benign papilloma and it is being treated as such.

Five patients had papillomata of the rectum which were within reach of the examining finger and which with one exception, protruded at bowel movement. It was therefore easy in this group to determine the physical characteristics of the tumor. In all but one, the tumor was soft and spongy, was not ulcerated, and had a point of attachment on the mucosa which presented no evidence of induration or fixation to underlying structures (Fig 11). Only one of these tumors was pedunculated (Fig 8). In these patients the microscopic picture bore out the clinical impression of the benign character of the tumor. The basement membrane was everywhere preserved and while hyper-chromatic and mitotic nuclei were occasionally seen, there was no infiltrative characteristics of carcinoma (Figs 9 and 10). The exception to this statement presented a very interesting problem (Case VII). A woman sixty-three, who had been operated upon for bleeding hemorrhoids two

## PAPILLOMATA OF THE LARGE BOWEL

years previous to the present observation had been bleeding from the rectum for six months and had suffered some sharp sticking pain in the rectum. Biopsy had been performed on the tumor mass situated just above the mucocutaneous line, which showed a benign papilloma microscopically. This tumor nearly encircled the rectum and was soft and villous in character except in one area about the size of a 50-cent piece, where there was induration and fixation of the tumor but no ulceration (Fig. 15). A biopsy of the tumor at this point of induration showed a carcinoma infiltrating the submucosa (Fig.

17). Due to the anæmia, weakness, and age of the patient, a posterior resection of the rectum was performed, removing the bowel well above the tumor mass including the fat and levator muscles surrounding the bowel. Sections including the whole thickness of the bowel over



FIG. 7.—Cell I. Magnification of 230 diameters shows character of columnar epithelium and connective tissue stroma in the papillary portion of the tumor.

the soft papillomatous area of the tumor showed in most places, a benign papillomatous structure without invasion of the basement membrane (Fig. 16). In many sections examined of the soft papillomatous portion of the tumor the cells presented hyperchromatic and occasionally dividing nuclei but there was no invasion of the basement membrane. Whether the tumor was malignant from the start with papillomatous overgrowth on the surface of the surrounding bowel as I believe it was, or whether it represents the early malignant degeneration of a papilloma is not easy to decide. The clinical appearance and "feel" of this tumor made the probable diagnosis of carcinoma reasonable, and before the biopsy of the indurated area I had no hesitancy in saying that radical removal of the bowel in which this tumor mass existed was advisable.

The remaining instance of papilloma of the bowel is questionable in that an examination of the patient, the only child in this series of patients, was not possible. Several large fragments of tumor material, regular in outline, but with a finely lobular surface, were the only evidence available for examination. The tumor masses had been passed spontaneously. The examination of this tumor microscopically (Fig 13), showed both adenomatous and papillomatous areas, which were benign in appearance as far as the specimens examined allowed one to say.

To summarize, we believe that where adequate clinical and microscopic



FIG 8 —Case V. Gross appearance of pedunculated villous tumor of rectum

examination of a papillary tumor of the large bowel is not possible to obtain, they should be radically removed, resecting, if necessary, the bowel in which the tumor is situated. If there are evidences of induration to palpation or microscopic evidence of breaking through basement membrane, tumor should be regarded as a carcinoma and radically treated as such. If, on the other hand, clinical evidence shows a soft, non-indurated tumor, fair presumption is that tumor is benign and should be treated by local removal. Microscopic examination is important, but should be weighed with the clinical examination of tumor.

*Treatment* —The treatment of papillomata, which are regarded with suspicion as to their malignancy, should involve the same surgical principles used in treatment for carcinoma of the large bowel, namely, wide removal of the bowel in which the tumor lies, including the lymphatics which drain that portion of the bowel.

In the benign papillomata of the lower rectum the tumor may be prolapsed through the anus, the healthy mucosa around the base of the tumor picked up by Allis forceps and an excision of the tumor carried out through healthy mucosa and submucosa. The defect in the mucosa made by such removal of the tumor may be partially closed by suture or allowed to granulate.

When benign papillomata lie above the point where they may be prolapsed through the anus the problem is harder. We have elected to treat such tumors by fulguration or actual cauterization through the proctoscope. This requires some special instrumentation and several sessions of treatment, but can be successfully done with a thorough cauterization of the base of attach-

## PAPILLOMATA OF THE LARGE BOWEL

ment of the tumor. One of the cases reported (Case III) is of this nature. We have not reported several other tumors which in appearance corresponded to papillomata by reason of their lobular easily bleeding surface because no adequate microscopic examination was possible. Treatment by fulguration and cauterization adds the element of acute inflammation to tumor growth which has some theoretical disadvantages. The alternative, however, of making a posterior approach to the ampulla of the rectum and opening the bowel into what has every appearance of a benign tumor does not appeal to me, even though adequate microscopic examination is lacking.

### CONCLUSIONS

(1) Benign papillomatous tumors of the large bowel are probably more common than the literature would indicate.

(2) There is a close relationship between adenoma and papilloma of the large bowel. Most papillomata have adenomatous constituents, some of which may be cystic.

(3) The relation of the origin of these benign epithelial tumors to inflammation is suggested.

(4) Papillomata of the large bowel should be regarded as pre-cancerous lesions and removed or destroyed.

(5) The diagnosis of malignant changes in papillomata of the large bowel should be made by clinical appearance and "feel" of the tumor as well as by the infiltrative characteristics of the tumor microscopically.

(6) Probably less than 25 per cent of papillomata of the large bowel are malignant at the time of their observation.

### REPORT OF CASES

Papillomata high in the rectum at the recto-sigmoidal junction or descending colon.

CASE I—Mrs. M. I. Entered Presbyterian Hospital, February 10, 1924, age fifty-seven. Referred by Doctor Allin.

Present complaint. For the past three weeks the patient has had a bloody diarrhea at which time she has had abdominal distress and cramps and marked urgency to go to stool. At each bowel movement a few tablespoonsful of bright red blood were passed and occasionally dark clotted blood would be expelled. During the day there was desire to go to stool about every fifteen minutes but at night time the urgency was much less. The present attack began in January, 1924, but lately the bleeding has become much more profuse and three days ago there was a severe hemorrhage during which time over a pint of blood was lost. The blood at this time was bright red and free from clots.

Past history. The patient has had four similar attacks of hemorrhage within the last two years coming about six months apart and lasting three to six weeks at a time, each attack having the same symptoms and in the period of remission microscopic blood being absent from the stools. During this period she has become increasingly constipated and has found it necessary to move her bowels by frequent cathartics. She is unable to say whether diarrhea would be present if she did not take cathartics. When the stools move they pass either a hard ball or small pieces of green material and to decrease this has been prescribed this preparation. At the time of her admission there has been no pain or tenesmus from the rectum and no pain at the recto-sigmoidal

history of disability in respiratory, cardio-vascular, or genito-urinary tracts is absent. There have been no ulcer symptoms. She has lost no weight.

Physical examination reveals a well-nourished, well-developed woman, not acutely ill. Slight pallor of the conjunctiva and buccal mucosa but no suggestion of jaundice. Regional examination is negative, except in abdomen where there is a generalized tenderness, especially along the descending colon. There is a spot of marked tenderness midway between iliac crest and costal margin on the left side. Rectal examination. There is a small fibrous polyp at the mucocutaneous line but otherwise digital examination is

negative and proctoscopic examination of the recto-sigmoidal junction reveals a normal bowel. Vaginal examination is negative.

Fluoroscopy of the colon February 12, 1924. Barium entered readily, filling the colon easily as high as the upper end of the descending portion. Here there was a definite irregularity consisting of a considerable constriction of the lumen for a distance of perhaps an inch. This finding remained constant throughout the entire



FIG. 9.—Case V. Magnification seven diameters of a section showing exquisite papillary arrangement of the tumor. At A are shown some dilated acinous structures resembling those found in pure adenoma.

examination. Immediately above and below this point there was an excellent filling of the colon and elsewhere the colon was well filled. Films depict the findings noted on fluoroscopic examination (Fig. 4), and show an irregular super-imposable filling defect just below the splenic flexure.

Films taken later show no definite retention in the colon above this defect.

Reexamination February 14 shows the same defect in the same position and of the same type as on previous examination. Findings are compatible with the filling defect from carcinoma.

Stool examination made on numerous occasions showed blood but very little mucus and no pus. Diagnosis was probable carcinoma of the descending colon, although a benign neoplasm was considered possible due to the history extending over two years,

## PAPILLOMATA OF THE LARGE BOWEL

the absence of cachexia the absence of obstruction of the bowel and the absence of pus in the bowel movement.

Operation February 16, 1924. Ether anesthesia. Left rectus incision. Descending colon from splenic flexure to sigmoid palpated. No tumor mass was made out. Feeling sure that the persistent filling defect in X-ray was not due to spasm the splenic flexure and descending colon was mobilized by division of the lateral peritoneal attachments and the bowel was delivered into the wound where it could be inspected and palpated more easily. About four inches below the splenic flexure a slight increase in the bulk of the intestine was felt as if some soft mass were present within the lumen of the bowel. This was not able to be milked downward or backward and was, therefore, regarded as the

mass responsible for the filling defect.

There was no change in the appearance of the bowel externally nor were there large mesenteric glands. The afferent and efferent loops of the bowel were sutured together opposite their mesenteric attachment by running catgut and the tumor-bearing part of bowel was anchored outside the peritoneum in first stage of a Mikulicz resection of the



FIG. 10.—C. C. A. Magnification sixty diameter. In the centre of the section are concentric rings with the epithelium. In the periphery of the section, fully 100 cells with little stroma covered by columnar epithelium rich in goblet cells.

Second stage of the Mikulicz resection February 18, 1924. Two days later the protruding loop of bowel was resected between intestinal clamps by cautery and the tube was inserted into the lumen of the upper segment. Bleeding mesenteric vessels were ligated.

the large bowel. The consistency was soft and spongy but somewhat more firm than the surrounding normal mucosa. It is easily movable and did not seem to involve the muscular or serous coats. There were two remaining areas of tumor growth very near to the tumor just described, but which had separate points of attachment to the mucosa of the bowel. The color of the growth was red.

Microscopic examination of the tissue from several different portions of the tumor, including the complete thickness of the bowel wall, revealed a benign papilloma (Figs 5, 6 and 7). The epithelium was greatly elongated into papillary extensions, in each of which was a connective-tissue stroma containing capillaries, fibroblasts, and wandering cells. The connective-tissue stroma in some places formed a miniature pedicle which extended into the epithelial mass of the tumor. At the base of these small pedicles

were round-cell accumulations and in several places areas of adenomatous tissue with acinous formation. The cells lining the rim were low with small nuclei at the base of the cells. Hyperchromatic or mitotic nuclei were not seen. The epithelium covering the delicate papillary projections of high columnar cells in which were seen numerous goblet cells. The nuclei were elongated deeply staining and situated at the base of the cells. In many areas the cells contained two or three nuclei of regular elongated shape. The basement membrane was everywhere intact and the muscularis mucosa was well defined and intact except in the fine papillary projections of the tumor. The submucosa and muscularis under the tumor was unchanged and not to be distinguished from normal bowel wall. Microscopic sections of the mesenteric glands showed no pathological changes.

The diagnosis was benign papilloma of the descending colon.

FIG. 11.—Case IV. Gross specimen of papilloma of the rectum.

April, 1925. The patient is well. Has no complaints. The fecal fistula has been closed for ten months.

CASE II—N. E., male, age thirty-eight. Entered Cook County Hospital, April 7, 1924, complaining of bleeding of bright red blood from the rectum, weakness, shortness of breath, and inability to work.

Past History. The bleeding has been present for one and one-half years and was thought to be due to hemorrhoids, which were removed nine months ago with only temporary relief. He has lost no weight. His color has been very anæmic, his skin and mucosa being almost transparent. He has been constipated and has some tenesmus at stool. He has had no pain. Denies venereal diseases. Wife has two children living and well. No miscarriages.

Examination revealed a well-nourished but very anæmic patient. General physical examination was negative except for a barely palpable spleen. Urine negative. Blood Wassermann negative. Blood Hemoglobin 28 per cent, red blood-cells 3,000,000. Stool examination negative except for blood. Fluoroscopy of colon was negative for pathological changes. Digital rectal examination was negative except for bright blood on the examining finger.

## PAPILLOMATA OF THE LARGE BOWEL

A proctoscopic examination, including the region 22 cm from the anus, revealed at a point 12 cm from the anus a bleeding surface which after application of adrenalin could be seen to consist of several finely lobulated papillary structures about  $1\frac{1}{2}$  cm in height with a sessile attachment to the mucosa. These appeared to snap into view over the end of the proctoscope which led us to believe that they had a slightly indurated consistency. The area of the bowel involved was about 2 to 4 cm long. A probable diagnosis of carcinoma of the rectum was made and colostomy was advised.

At exploratory operation, the rectum at the peritoneal reflection was soft and unchanged in external characteristics, but an indefinite small mass was thought to be felt in the bowel. There was no glandular involvement. The picture from the abdominal

side was not that of carcinoma or diverticulitis. A colostomy without dividing the bowel was done.

Following the operation  $1/10$  per cent silver nitrate five-minute retention enemas were given daily per rectum. The hemorrhage ceased and the welfare of the patient improved in every way. His blood picture gradually returned to normal and he urged that his colostomy be closed.

Repeated proctoscopic

examinations during the succeeding ten months showed a bleeding surface but a gradual recession of the papillary tumors, until finally no tumor was visible and the surface of the bowel was practically normal. We have no explanation to make for this phenomenon. Still feeling that a carcinoma might be present where these papillomata were, pieces of tissue were removed from the bowel wall through the proctoscope, but no tumor tissue was seen. In the beginning of 1925, several elevated papillary masses with sessile attachment of about  $\frac{1}{2}$  cm in diameter appeared on the mucosa of the colostomized bowel. These were excised and a microscopic study of them shows an elevated epithelial covering with papillary elongations, the epithelial cells of which are columnar, with well-stained basal nuclei. The basement membrane is intact (Fig 12). There is no particular evidence of round-cell or polymorphonuclear exudate at the base of, or in the tumor itself. It appears that the mucosa of the colostomized bowel was involved by the same type of papillary epithelial tumor growth that affected



FIG 12—Case II. Magnification sixty diameters of small papillomatous tumor occurring on mucosa of colostomized bowel showing intact muscularis mucosa round-cell infiltration in connective-tissue base and branching papillary projections, covered with columnar epithelium rich in goblet cells.



the ampulla of the rectum After excision of these tumors they did not recur in the few weeks that the bowel was open to inspection

Yielding to the constant plea of the patient that the colostomy be closed, this was done in the latter part of March, 1925 What the future of this patient will be is problematical It seems to me proper, however, to include this unusual case in the list of papillomata of the large bowel

#### Papillomata in the ampulla and lower rectum

CASE III—R McC, male, age forty-eight Entered Presbyterian Hospital, March 7 1925 Referred by Doctor Stevens, complaining of blood in stools and distress in

lower abdomen

Patient states that about two months ago he began to have an uncomfortable feeling in his lower abdomen, just below the navel in the midline The distress is more like a burning sensation than a pain The distress is not affected by eating or by bowel movements

About three weeks ago the patient noticed considerable blood in his stool The blood was very dark The patient states

he has not noted it in his stools since From the time he noted this blood his stools have been rather mushy in character and brown in color He states he has no distress on bowel movements His general health is good He has lost no weight

A general examination of the patient was essentially negative as far as pathological processes were concerned with the exception of the proctoscopic examination Twelve centimetres from the anus a finely lobulated bright red tumor mass, consisting of several coarse lobes, was attached by a broad base to the right anterior aspect of the ampulla of the rectum Part of the attachment was on a prominent valve of Houston, and the remainder of the attachment ran behind the valve and required considerable air dilatation to reveal it The tumor was about the size of an English walnut and was partially hidden by the prominent valve mentioned It was freely movable and could be prolapsed for an inch when grasped by a fine forceps The surface was not ulcerated and there was no evidence of indurated fixation of the tumor to the bowel wall

The appearance of the tumor and the clinical history was that of a benign papilloma

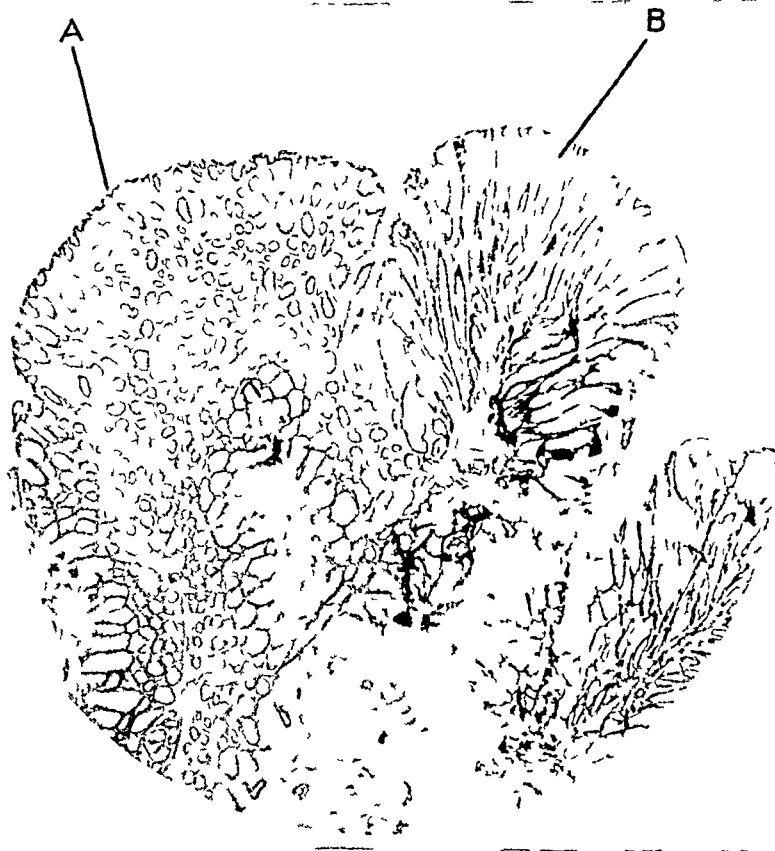


FIG 13 Case IX Magnification twelve diameters of a section of tumor fragment showing A adenomatous structure, B papillomatous structure

## PAPILLOMATA OF THE LARGE BOWEL

A biopsy of the tumor had been performed before the patient entered the hospital. An examination of these sections, which did not include the attachment of the tumor to the bowel, showed typical papillary projections, with a fine stroma of connective tissue containing thin-walled blood-vessels, wandering cells and occasional round cells. The epithelium covering the papillary stalks was columnar, with well staining, often multiple long nuclei. Mitoses were rare. Goblet cells were rather numerous. While the microscopic examination of the tissue was not conclusive because only a small portion of the tumor was examined, the clinical history and physical characteristics of the tumor indicated its benignancy.

### *Treatment*

—Fulguration of the tumor in several sessions was elected as the most conservative treatment, as the tumor had every appearance of being benign. This treatment is now being carried out.

### CASE IV—

Mrs F M  
age forty-three  
Referred by  
Dr R C  
Brown. Patient  
has had marked  
bleeding from  
the rectum  
associated with  
protrusion of a  
soft mass at  
bowel move-

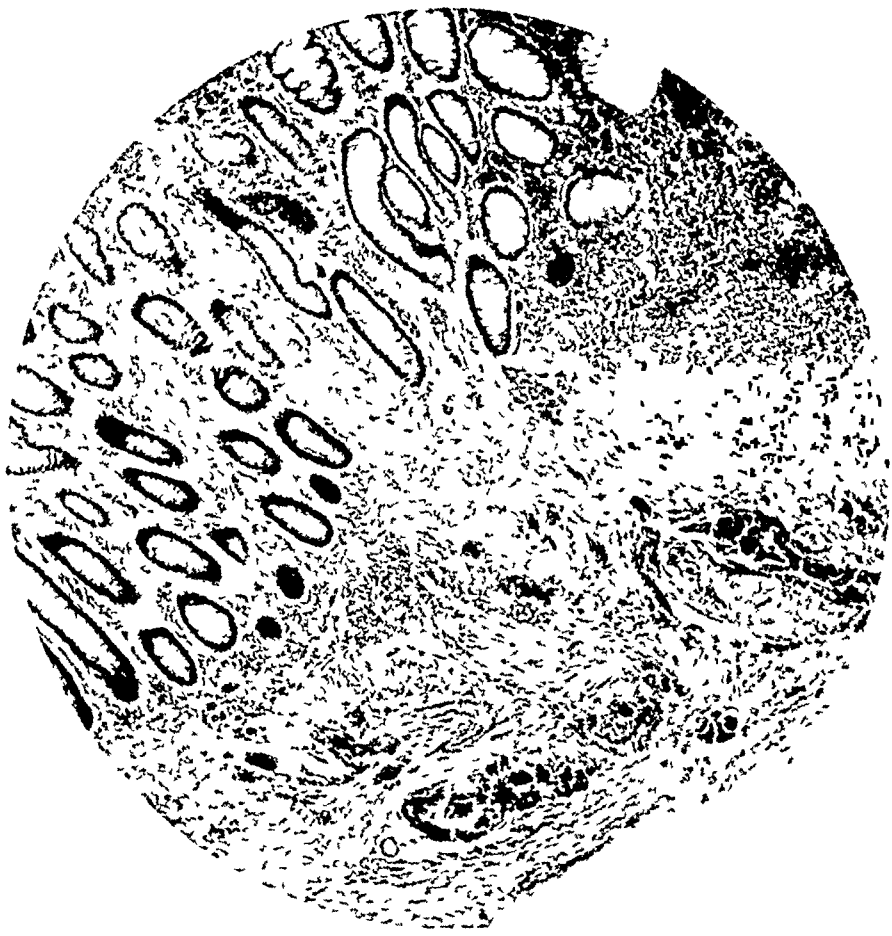


FIG 14—Early malignant degeneration of simple adenoma of the rectum, showing infiltrative characteristics with penetration of basement membrane

ment for several years. She had always thought she had hemorrhoids. There were no general symptoms or complaints except constipation. The general examination of the patient was essentially negative. Rectal examination revealed a soft, easily bleeding tumor mass about the size of a hen's egg, red in color, with a coarse lobular contour and a finely lobulated surface. It was attached by a broad base about one inch in diameter to the right anterior portion of the rectal mucosa just above the mucocutaneous line. There was no induration at the base of attachment (Fig 11—Gross specimen).

Under  $\frac{1}{2}$  per cent novocain anæsthesia the tumor was removed by cautery, removing normal mucosa and sub-mucosa around the tumor.

The microscopic examination of tissue from several portions of the tumor, including the base of attachment confirmed the clinical diagnosis. In several places there were small connective-tissue projections into the tumor mass which contained thin-walled blood-vessels and wandering cells. There were also widespread accumulations of round cells. This round-cell accumulation was very marked in some places in the tumor and

could be regarded as a chronic inflammatory change. The epithelial covering of the tumor consisted of columnar cells which contained elongated nuclei. Most of the nuclei were stained deeply but in some areas of the tumor the nuclei were vacuolated. There were occasional goblet cells scattered throughout the epithelium. The basement membrane was everywhere intact and there were no infiltrative changes in the tumor grossly or microscopically.

At the point of attachment of the tumor to the bowel wall there were some adenomatous structures consisting of acini lined with columnar epithelium and having the appearance of the acinous structures found in adenoma of the bowel. These structures were, however, only occasional and did not predominate in any of the sections studied.

The diagnosis was adenopapilloma of the rectum.

#### CASE V—

R. T., male, age fifty-five. Dr. D. W. Graham's patient. Entered Presbyterian Hospital February 24, 1920, complaining of a protruding mass from the rectum, bleeding from rectum, pain in lumbar region.

Rectal complaint has been present one year. A mass

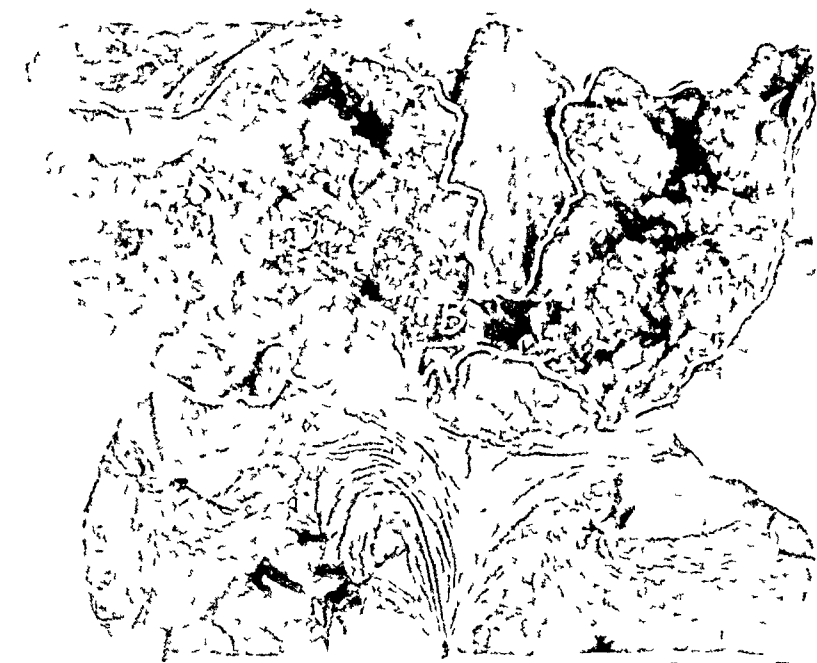


FIG. 15.—Case VII. Gross specimen of tumor of the rectum showing soft papillary, non indurated tumor at A and a small area of carcinomatous indurated tissue at B.

which has constantly grown larger has prolapsed at each bowel movement. The mass has bled freely each time and there is practically always blood on the stools.

He has lost about 85 pounds in weight in one year.

Operation, February 15, 1920. The sphincter ani was dilated with the fingers. A villous mass, about the size of a lemon, and attached by a pedicle to the right posterior wall of the anal canal, was delivered. The pedicle was transfixed and the tumor cut away.

Grossly the tumor mass was soft and spongy, red in color, with no areas of induration. The many papillary projections were striking because of the delicacy of their structure and unusual length. The appearance justified the name of "villous tumor." The point of attachment to the mucosa was a pedicle about 1 cm. in diameter which appeared to be covered with normal mucosa of the bowel. Figure 8 shows the size and shape of the tumor, but as the picture was taken five years after the removal of the tumor, the finer details of structure are lost. Figure 9 shows the gross villous character of the tumor.

Microscopically, the connective-tissue stroma was very marked at the point of attachment of the tumor and this broke up into numerous branches re-dividing many times to form a framework for even the finest papillary projections. There were present gland-like structures in the connective-tissue stroma lined with low columnar or flat epithelium. The acini varied in size and in the height of the columnar cells lining them.

## PAPILLOMATA OF THE LARGE BOWEL

Some were considerably dilated and cystic as are so commonly found in pure adenoma of the large bowel (Fig 10)

The columnar epithelium covering the papillary projections corresponds in character to that described for the preceding specimens. There were a few isolated accumulations of round cells in the tumor. Nowhere was there a tendency for the tumor to infiltrate.

Diagnosis Benign pedunculated villous tumor

The later history of this patient is not available

CASE VI—W Y, male, age fifty Entered Presbyterian Hospital, June 14, 1920, complaining of bleeding from rectum, protrusion from rectum, irritation of rectum

Patient states he has had some rectal trouble all his life. His mother told him he had a hemorrhoid at the time of his birth. This has not annoyed him to any marked degree until about six years ago, when he noticed a protrusion from the rectum. There had been some bleeding at various intervals, mostly at the time of bowel movement. The "polypus" has been getting larger and of late has annoyed him considerably.

Rectal examination revealed a red lobulated tumor mass about one



FIG 16—Case VII Magnification eight diameters of section through junction of papillomatous tissue and normal mucosa (A on Fig 14) shows papillary character of the tumor with absence of infiltration

inch in diameter, attached by a sessile base to the right anterior quadrant of the lower rectum. There were also internal hemorrhoids in other quadrants of the rectum covered with smooth mucosa. The papillomatous tumor, as well as the hemorrhoids, were removed by cautery.

Grossly this tumor was about the size of a hickory nut with a flat sessile attachment to the mucosa. The color was red, the consistency was soft and spongy. The surface of the tumor was made up of several coarse lobules which, in turn, were finely lobulated. There were no indurated areas in the tumor.

Microscopic examination showed the tumor taking the place of the normal mucosa of the bowel without any special pedicle, although there were projections of connective tissue into the tumor at several different places. In the region of the muscularis mucosa there were numerous areas of round-cell infiltration. There was no marked vascularity of the tumor. In main, the tumor was adenomatous, consisting of varying sized acini,

some with marked cystic degeneration. In the periphery of the tumor there was a tendency for papillary elongations, some of which branched and re-branched. Here the epithelium was higher, the nuclei were more elongated and in several places mitotic figures were seen. There were very few goblet cells. There was no microscopic evidence of infiltration seen in this tumor. Diagnosis: Adeno-papilloma of the rectum.

CASE VII—Mrs E. G., age sixty-three. Entered Presbyterian Hospital, September 17, 1924. Referred by Doctor Clark.

For the past six months the patient has noticed blood in her stools. This was not always present during that period, but she says she never went for more than a day or so without seeing blood. She thinks that when bleeding stopped her pain was more intense.

Pain is described as a pressing pain, like pins and needles, and is much worse when patient sits down. This has gradually grown worse during the last month and is now so marked that she remains standing when on the "L" or surface cars. She has lost considerable weight and feels weak.

While the patient always enjoyed good health she has had a certain amount of urinary disturbance. For the last few years



FIG. 17—Case VII. Magnification sixty diameters of tissue taken from B. FIG. 14 shows infiltrative characteristics of the tumor. Adeno-carcinoma.

patient has had to urinate ten or twelve times daily and often sits on the toilet for an hour or two at night. Says she urinates often but passes only a few drops at a time. She was operated upon for hemorrhoids two years ago, at which time she had considerable bleeding in the stool. She was a pale, feeble old lady. Blood-pressure 170. Haemoglobin 85 per cent, red blood-cells 4,400,000, white blood-cells 6400. Pus in urine. Heart, lungs and abdominal examination negative. No oedema of extremities.

Rectal examination revealed a tumor mass, consisting of soft spongy tissue, almost fills the lower portion of the rectum. At one portion in an area about one inch in diameter, there is an indurated area in the mass which feels like a malignant tumor. By inspection, the tumor which is visible through a speculum is soft and waxy and has the typical appearance of a papilloma. There is no pus or old blood in the rectum.

Before the patient came to the hospital a biopsy on the tumor had been done which showed benign papilloma. Both Doctor Clark and I thought that the indurated character of one area in the tumor was very suggestive of malignancy. Another biopsy was

## PAPILLOMATA OF THE LARGE BOWEL

therefore done, taking some of the indurated area, as well as some of the soft spongy portion. The former showed an infiltrating carcinoma and the latter a benign papillary tumor without rupture of the basement membrane. The patient was advised to have a resection of the rectum from below because the tumor was low and her general condition was such that it was thought she could not stand a more radical combined operation.

Under ether the rectum, levator muscles and fat was excised well above the tumor mass by a Kraske posterior operation and the healthy bowel was drawn down and attached to the skin. She made a slow but uneventful recovery, has regained her normal weight, color, and at the present time has no evidence of recurrence.

The specimen consisting of the terminal six inches of the bowel, revealed when opened, a tumor mass beginning just above the muco-cutaneous line and involving the entire circumference of the bowel with the exception of a small area on the anterior wall. The mass extended upward about two inches and was in most places red, soft and velvety, consisting of coarse lobules which in turn had a fine lobulated surface. There was no ulcer crater or gross ulceration, but on the posterior surface of the bowel was an indurated area about one inch in diameter which was slightly raised above the level of the remainder of the tumor (Fig 15—Gross specimen). The glands in the fat surrounding the tumor contained no carcinoma. Sections were cut through the entire thickness of the bowel wall through the indurated area (B), and at two places (A) in the soft part of the tumor. The tumor in the indurated area showed typical infiltrating adeno-carcinoma involving the muscularis and extending laterally under the mucosa (Fig 17). In the soft tumor areas the microscopic picture was much like that described in the benign papillomatous lesions, except that mitoses were rather common as were hyper-chromatism of the nuclei (Fig 16). Whether this tumor was malignant from its inception, as I believe, or whether we had a benign papilloma undergoing malignant degeneration is difficult to say. The clinical picture, however, determined the diagnosis of malignancy in face of contrary microscopic evidence.

CASE VIII—Male, age sixty. Came to Cook County Hospital for treatment of chronic myocarditis.

He was referred from a medical ward because of a protrusion and bleeding of bright red blood from the rectum.

Rectal examination revealed a round globular tumor mass about one inch in diameter situated on the mucosa of the anterior wall of the rectum, just above the muco-cutaneous line. This tumor was red in color, consisting of several coarse lobules which in turn were finely lobulated. The tumor was soft and spongy and had no induration at its base. It was removed under local anæsthesia by cautery, going well outside the tumor through the normal mucosa and beneath the tumor into the sub-mucosa. The patient made an uneventful recovery.

Microscopic examination of the tissue showed the tumor taking the place of the normal mucosa of the bowel. Only a slight amount of connective-tissue stroma was present in the tumor. Muscularis mucosa was everywhere intact and occasionally was elevated and ran into the tumor lobules as part of the connective-tissue stroma which was very fine and contained round-cell accumulations and thin-walled blood-vessels. The epithelium of the tumor was of both adenomatous and papillary types. The adenoma consisted of acini in the connective-tissue stroma with columnar cells containing basal nuclei. There were numerous goblet cells present in the epithelium. Other portions of the tumor consisted mainly of papillary projections with a sparse connective-tissue stroma covered with high columnar cells with basal nuclei. The muscularis mucosa was everywhere intact and there was no infiltrative characteristics seen in the tumor. The diagnosis is adeno-papilloma of the rectum.

CASE IX—Consists of material passed at bowel movement by a child. There was no history of the patient available.

The material consisted of three globular, finely lobulated tumor masses, without

pedicles, varying in size from  $\frac{1}{2}$  to  $1\frac{1}{2}$  cm in diameter. They were soft and spongy and nowhere ulcerated. In color they were bright red.

The microscopic examination showed tumor tissue consisting of a connective-tissue stroma containing many blood-vessels, round-cell accumulations and wandering cells. In this stroma were typical adenomatous structures lined with low columnar epithelium with basal nuclei. There was little tendency to cyst formation. In other areas there were well-defined elongated papillary projections covered with columnar epithelium, with long, well-staining basal nuclei. A slight magnification of the microscopic slide showed the adenomatous and papillary structure of the tumor side by side (Fig 13).

This tumor is, I believe, an adeno-papilloma with spontaneous expulsion of tumor fragments. The absence of a history and physical examination of the patient makes the diagnosis questionable.

#### BIBLIOGRAPHY

- <sup>1</sup> Text-books Allingham, 1882, Wright, 1884, Mathews, 1892, Kelsey, 1893, Ball, 1910, Hirschman, 1913, Delbet and Brechot, 1916, Gant, 1923, Mummary, 1923, Pennington, 1923
- <sup>2</sup> Rotter Handbuch d Pract Chir 14 Auflage
- <sup>3</sup> Goebel Beitrage z klin Chir, 1914, vol 101, p 598
- <sup>4</sup> Quenu and Landel Revue de gyn de chir abd, Fevr, 1899
- <sup>5</sup> Belleli Progress med, 1885, vol 111
- <sup>6</sup> Milton Jour of Tropical Med, June and July, 1902
- <sup>7</sup> Ruffer Brit Med Jour, Jan 26, 1901
- <sup>8</sup> Mummary Text-book, 1923

#### CASE REPORTS

- <sup>9</sup> Blanc Paris Chirurg, 1919 vol 11, p 192
- <sup>10</sup> Frank Transactions Chicago Surg Soc, Surg, Gyn, Obs, vol 111, p 527
- <sup>11</sup> Adams Transactions Amer Proctological Soc, 1922, vol 111, p 70
- <sup>12</sup> Cope Brit Jour of Surgerv, 1921, vol 11, p 558
- <sup>13</sup> Willis Old Dominion Jour Med and Surg, Richmond, 1913, vol 11, p 149
- <sup>14</sup> Drueck Chicago Med Recorder, 1917, vol 111, p 455

## CARCINOMA OF THE BODY OF THE UTERUS\*

A STUDY OF FIFTY CASES AT THE MASSACHUSETTS GENERAL HOSPITAL

BY LINCOLN DAVIS, M D  
OF BOSTON, MASS

THE cases upon which this report is based comprise all the microscopically proved cases of primary carcinoma of the body of the uterus which are recorded at the hospital between January 1, 1914, and January 1, 1925 †

Carcinoma of the body of the uterus is a disease entity quite distinct from carcinoma of the cervix, histologically and clinically. It is far less common than

the latter. Statistics from the Mayo Clinic show the incidence of cancer of the body to be about one-third of that of cancer of the cervix. Norris's<sup>1</sup> figures for the University Hospital,

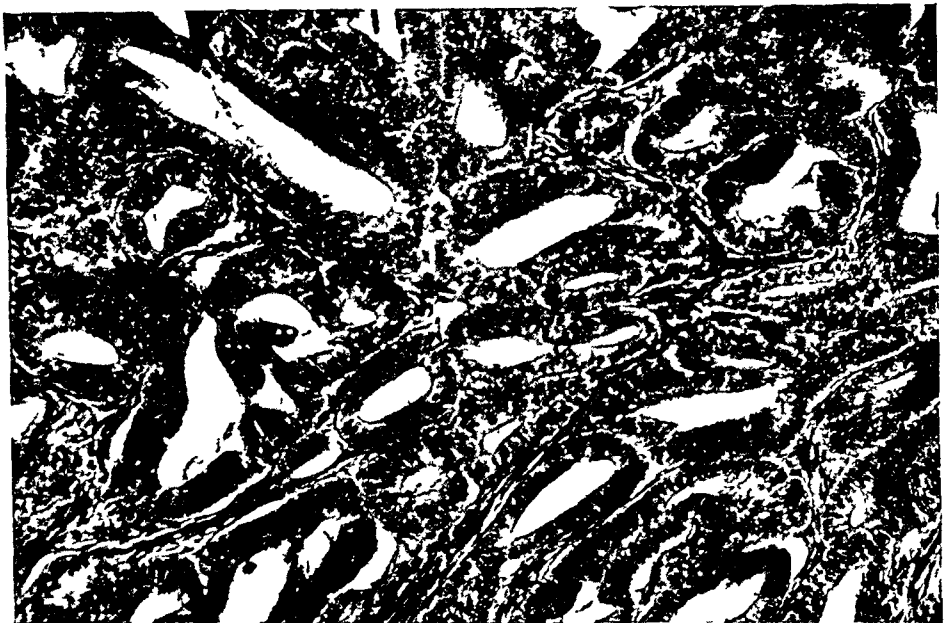


FIG 1 —Photomicrograph of adenocarcinoma of uterus showing secondary cellular differentiation. Grade II. Patient living and well three years after operation (Case E S, 249376 Spec 22-6-70)

Philadelphia, are about the same. Others place the relative incidence of fundus cancer very much lower.

Carcinoma of the body of the uterus may be circumscribed or diffuse, but even in the advanced cases it rarely involves the cervical canal. It usually takes the form of papillary or polypoid outgrowths into the endometrial cavity which cause definite though moderate enlargement of the uterus. There is at the same time a tendency of the growth to invade the myometrium, the serosa may ultimately be reached with dissemination of the disease into the peritoneal cavity. Ovaries and tubes are frequently secondarily involved. The ovaries were involved in five of our cases (10 per cent). Accompanying myoma was found in eleven of our cases (21 per cent), this is about the proportion reported in other clinics.

\* Read before the American Surgical Association, May 4 1925

† For the privilege of reporting these cases, grateful acknowledgment is made to the surgeons of the Hospital Staff



Adenomyoma is also found in association with adenocarcinoma, and some authorities consider it to be an etiological factor of some importance. It was found but once in this series (Case W S, 212268, Fig 9)

Ewing<sup>2</sup> recognizes four types of carcinoma of the body

- 1 Malignant adenoma—the most frequent type, in which there is giant reproduction of the uterine glands with little stroma
- 2 Papillary adenocarcinoma—characterized by polypoid outgrowths



FIG 2—Same specimen as Fig 1 showing squamous cell epithelium at tip of papillary process. An example of metaplasia (Spec 22 6-70)

- 3 Alveolar carcinoma—a less common form in which the cells are packed in solid masses

- 4 Adeno — acanthoma—a still rarer form in which squamous cells predominate over the glandular type

There was no case of the latter in this series, but there were many specimens exhibiting extraordinary degrees of metaplasia from glandular epithelium to typical stratified epithelium composed of squamous cells with epithelial pearls, etc. There was one case of carcinoma of the body in which the primary growth in the uterus was of the alveolar carcinoma type, at autopsy definite squamous-cell infiltration of the retroperitoneal lymph-nodes was found (Case No 242065)

Although the histogenesis of carcinoma remains uncertain, there undoubtedly is an early stage of the disease when it is limited to the mucosa. Ewing instances cases where curettings have shown carcinoma, and yet the extirpated uterus has shown no trace of the disease. This may also be explained on the hypothesis of the malignant transformation of a uterine polyp which has been completely removed by the curette. In this series there were two cases in which the curettings were reported as adenocarcinoma, and yet the uterus subsequently removed by operation showed no evidence of carcinoma. These cases cannot, however, be claimed as proved, as the specimens of the curettings have unfortunately been lost, and were not therefore subject to a critical review by Dr H F Hartwell, the clinical pathologist, who has kindly gone

## CARCINOMA OF THE BODY OF THE UTERUS

over all the specimens. These two inconclusive cases, therefore, in which the patients are living and well, are not counted among the "cures."

There have been no less than seven cases in which a uterine polyp was either present at the time of entrance to the hospital, or had been removed previously. The frequency of this condition suggests some etiological relationship, and certainly lends color to the hypothesis of the malignant degeneration of benign polyps.

That the type of cell plays an important part in the malignancy of tumors has long been known, but the subject has been greatly advanced in the case of the epithelial tumors by the recent researches of MacCarty<sup>3</sup> and Broders.<sup>4</sup> Mahle<sup>5</sup> has studied the vast material of the Mayo Clinic in

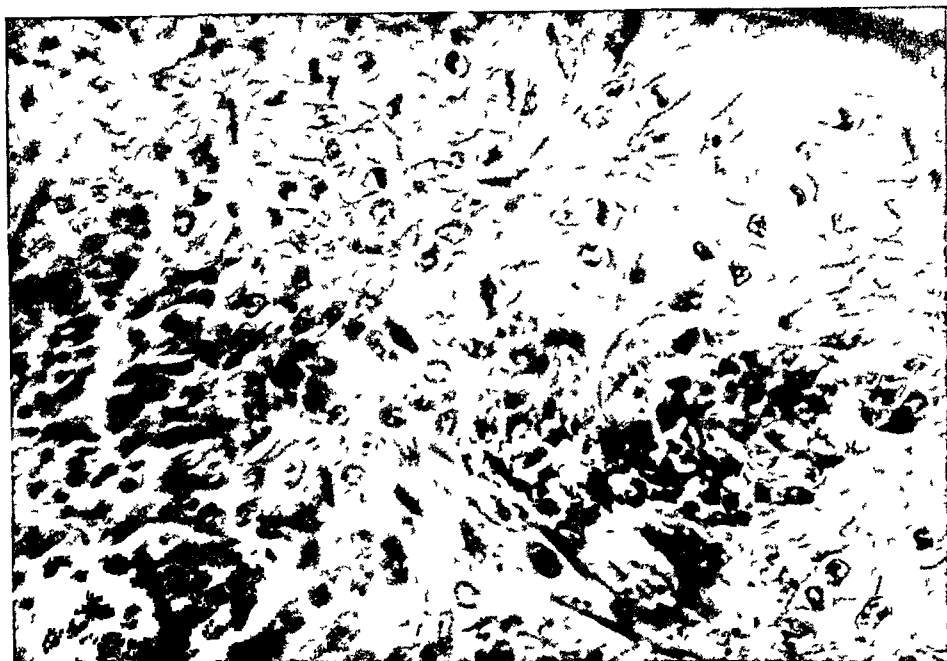


FIG 3 —High power photomicrograph of Fig 2 showing squamous epithelium (Spec 22-6-70)

cancer of the body of the uterus, some 186 cases, with a view to grading the malignancy of the cases according to cellular differentiation. His studies show a very direct relationship of longevity to degree of differentiation.

While other factors such as form and extent of growth, amount of myometrium invaded, involvement of lymph-nodes, duration of symptoms and general resistance of tissue, are of importance in forming a prognosis, Mahle believes that "taken as a whole, cellular differentiation appears to be the most important factor."

Dr J. V. Meigs studied the microscopic specimens of thirty-eight cases in this series, from this viewpoint, without knowledge of the clinical histories. He placed twenty-nine cases in Grade II, three cases in Grade III, six cases in Grade IV, none in Grade I. While the clinical results in this small number of cases were found to be in general conformity with Mahle's deductions, there have been some very striking exceptions. Of the six cases in Grade IV—two are living and well three and a half years (Case E S, 246011, Figs 4 and 5) and two years, respectively, after operation, and another (Case E S, 221686, Fig 6) died of recurrence six years after operation, having enjoyed a period of five years of good health. The other three succumbed rapidly to the disease.

The average age of the patients in this series was fifty-four. Forty-two patients had been married. Thirty-two had borne children. Eight were single. Thirty-four, or nearly 70 per cent, had passed the menopause by more than one year.

The chief symptoms of the disease are hemorrhage and discharge. Abdominal pain of a colicky character, probably due to obstruction in the uterine canal, is often quite characteristic.

Hemorrhage and discharge coming on after the menopause is pathognomonic of cancer of the uterus, and yet how often are these telltale symptoms



FIG. 4.—Adenocarcinoma of uterus showing area of primary cellular differentiation (Spec. 21-10 114)

ignored by doctors as well as patients. The onset of bleeding after the establishment of the menopause for a year, means cancer nine times out of ten, and calls for an immediate and accurate determination of the cause.

There seems to be a

widespread misapprehension among doctors that post-climacteric bleeding may be due to fibroids, this is very rarely indeed the case in my experience. In reviewing the histories of these cases the diagnosis fairly screams aloud in over half of them. There were no less than thirty cases in which post-climacteric bleeding had been going on for six months to four years or more. There were fourteen cases in which the post-climacteric bleeding had been noted for two years or more, and yet in this last group of cases there have been six three-year "cures" by operation, or 43 per cent. What a contrast this offers to carcinoma of the cervix in which a duration of symptoms of six months almost invariably spells the patient's doom.

In cases of carcinoma of the body of the uterus occurring before or at the time of the menopause, the diagnosis is much more difficult. Diagnostic curettage must be resorted to in all cases of doubt. Theoretically, curettage of a carcinomatous uterus seems undesirable not to say dangerous, but clinical experience seems to show that if hysterectomy follows immediately after, or

## CARCINOMA OF THE BODY OF THE UTERUS

at most after an interval of not more than a few days, dissemination of the disease does not take place

Norris has made a special study of this question, and his cases show an actual slightly greater percentage of cures with preliminary curettage, than in those in which immediate hysterectomy without curettage was done

In our series, twenty-two cases had preliminary curettage, and twenty did not. In eight cases hysterectomy followed curettage immediately, being done at the same sitting. In thirteen cases hysterectomy followed after an interval of

not more than a few days. There was one exceptional case in which there was an interval of fourteen months, during which time radium was used. Death resulted from recurrence three years after hysterectomy in this case.

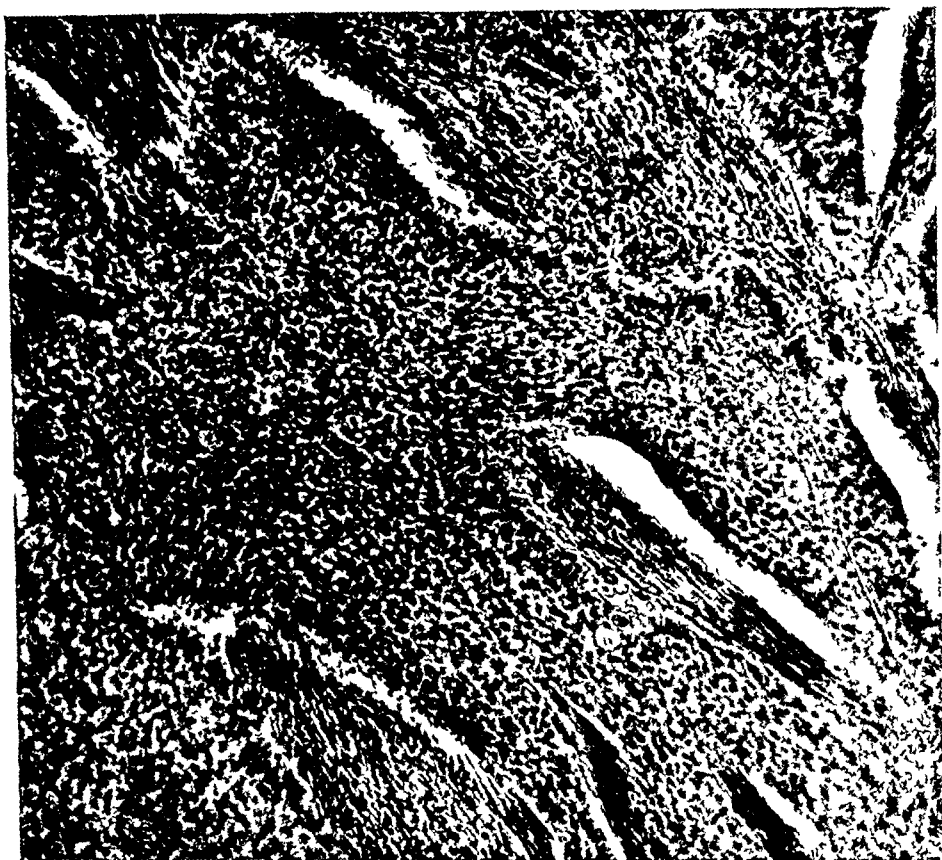


FIG 5 —Same specimen as Fig. 4, showing area with no cellular differentiation. Such areas predominate. Grade IV. Patient living and well, three and a half years after operation. (Case E S, 246011, Spec 21-10-114.)

The end re-

sults in the cases subjected to preliminary curettage have been but slightly inferior to those in which it was not done. There were eight three-year "cures" in the former group, and ten in the latter.

The diagnostic importance of preliminary curettage is so great, that in my opinion it should be resorted to in all doubtful cases, to be followed by immediate hysterectomy at the same sitting if the curettings are found to be positive. The practical advantages of an early and positive diagnosis outweigh the theoretical dangers of dissemination of the growth.

The accepted treatment of carcinoma of the body of the uterus is total hysterectomy with removal of the adnexa. There is some difference of opinion as to the relative advantages of the abdominal and vaginal routes. Personally I favor the former as a routine, on the ground that there is less traumatization of the tumor, and that intra-peritoneal complications such as adhesions, ovarian cysts, metastases to the ovaries, etc., can be more satis-

factorily dealt with. Vaginal hysterectomy has certain advantages in the obese and aged, and its results have been little if at all inferior to the other. The immediate mortality is slightly lower while the ultimate mortality is somewhat higher.

In this series of fifty cases, hysterectomy was done in forty-two. In three cases exploratory laparotomy disclosed inoperable conditions due to extension of growth or metastases. Four cases were treated with radium. One very advanced case was subjected merely to diagnostic curettage. The actual per-

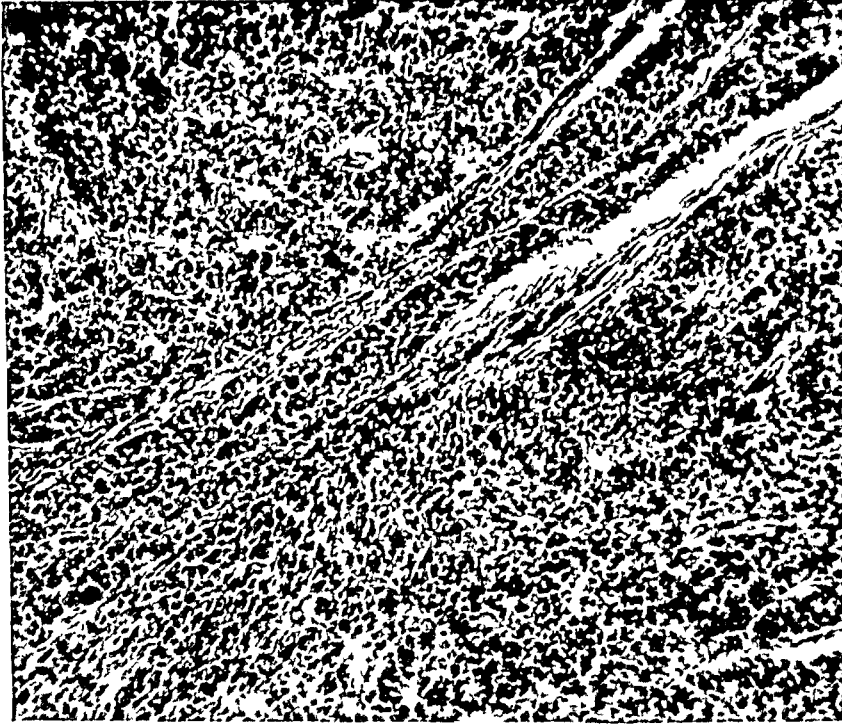


FIG. 6—Adenocarcinoma of uterus showing no cellular differentiation. Grade IV. Patient died of recurrence six years after operation. (Case E 5 221686 Spec 18471)

centage of operability for the radical operation was eighty-four. This is strikingly high as compared to the operability of cancer of the cervix. In reviewing these cases, there was one case which was subjected to hysterectomy and resection of the sigmoid on account of

invasion by the growth, which would generally be considered inoperable, and two cases subjected to radium treatment which would generally be considered operable. The other two radium cases were so treated on account of age and general debility rather than on account of any local contra-indication to operation. Only five cases out of the fifty were definitely inoperable from extent of the disease.

Too few cases were treated with radium to permit of any definite conclusions. One patient who was not operated upon on account of diabetes, is reported to have died of internal hemorrhage a few days after radium treatment. This suggests the possibility of perforation of the uterus with intraperitoneal hemorrhage. One patient is living and well one year after radium treatment. One patient had three years of good health after radium treatment, but succumbed to the disease in the fourth year. On the whole, it seems that for the present, at least, in carcinoma of the fundus, operative

## CARCINOMA OF THE BODY OF THE UTERUS

treatment should be preferred, being comparatively satisfactory both as to immediate and late results, with operability rate very high, while radium treatment on account of the location and nature of the growth is somewhat uncertain, and not without danger.

There were twenty-one total abdominal hysterectomies, eight vaginal hysterectomies, and thirteen supravaginal hysterectomies. There were four operative deaths, a mortality of 9.5 per cent. It may be said in extenuation of this high mortality, that in one fatal case a resection of the sigmoid which was secondarily invaded by the growth, was done at the same sitting. In another case the patient was a diabetic, and died in coma.

While probably few surgeons would advocate supravaginal hysterectomy as routine treatment for adenocarcinoma of the fundus, nevertheless it quite frequently happens that this incomplete operation is done. It is the result usually of error in pre-operative diagnosis. The surgeon believing that he is dealing with a case of simple myoma, makes no effort to remove the cervix, and if he is fortunate, it



FIG. 7—Circumscribed papillary adenocarcinoma of the body of the uterus (Case E. S., 200758, Spec. 15-3-129)

is not until the specimen is cut that the true condition is recognized. More often, unfortunately, the surgeon is made aware of the true state of things, when upon cutting across the cervical canal there is an exudation of soft carcinomatous material into the field of operation. He is then faced with the difficult problem of removal of an infected cervical stump. This happened in this series more than once. This unfortunate dilemma is to be avoided by preliminary curettage in all cases of fibroids, or other conditions in which supravaginal hysterectomy is contemplated. Figures show that myomata are found in 20 per cent of cases of carcinoma of the fundus, and that carcinoma is found in about 3 per cent of all myomatous uteri. Therefore it behooves us to be on the lookout for carcinoma in dealing with fibroids.

The gross character of the curettings will in many cases give the true diagnosis, where there is doubt, it is only necessary to wait for the report of

a frozen section which can be readily available before the stage of cervical removal is reached. The only other alternative is to perform total hysterectomy as a routine in all cases of fibroids, as recommended by several gynecological authorities.

At the Massachusetts General Hospital for the period of five years between January 1, 1917, and January 1, 1922 out of one hundred and twenty-three cases of cancer of the cervix, admitted there were eight cases of cancer of the cervical stump after supravaginal hysterectomy for fibroid

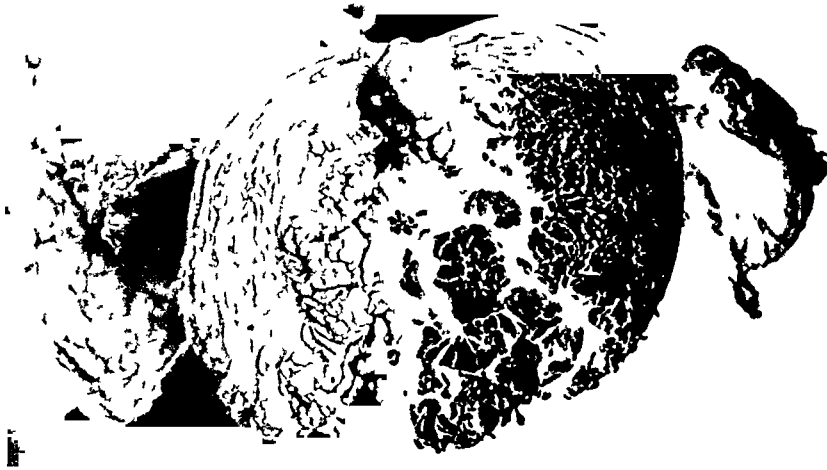


FIG. 8—Diffuse papillary adenocarcinoma of the body of the uterus. Supravaginal hysterectomy in 1916. Patient free from recurrence in 1925. (Case W. S. 206886 Spec. 16-3-2.)

tumors.' In four cases the original operation for fibroids had been done at this hospital, while in four others it had been done elsewhere. In five of these eight cases the early appearance of vaginal dis-

charge and bleeding after the operation makes it very probable that the disease in the cervix was already coexistent at the time of operation. In fact, in one case the pathological examination showed this to be so.

Undoubtedly there are many early cases of carcinoma of the body, in which the disease is sharply limited to a small area in the fundus, and in which supravaginal hysterectomy gives adequate removal as far as the growth itself is concerned, as our results seem to show. Six three-year "cures" in ten supravaginal hysterectomies, 60 per cent. There is no way, however, of accurately determining beforehand the limitations of the disease, and it is certainly not safe in the long run to take such chances. While supravaginal hysterectomy, combined with reaming out of the cervical canal with the knife or actual cautery, may be efficient in removing beginning carcinoma of the endocervix, my chief objection to the operation is the danger of contamination of the field from exudation of carcinomatous material, rather than the danger of incomplete removal of the growth.

Other important matters of technic in performing hysterectomy for carcinoma of the body of the uterus which I wish to emphasize are (1) Avoidance of the use of tenacula in the fundus, traction should be made by means of clamps applied to the broad ligaments. (2) Preliminary ligation or clamping of the distal extremities of the tubes to prevent exudation of carci-

## CARCINOMA OF THE BODY OF THE UTERUS

noma cells from the fimbriated ends (3) Preliminary disinfection of the vagina and closure of the cervical canal by packing and suture to avoid possible exudation of infectious material from that source

It was formerly generally believed that adenocarcinoma of the body of the uterus, treated by hysterectomy, yielded a very high percentage of "cures" Re-

cent statistical studies from the Mayo Clinic,<sup>5</sup> the University Hospital, Philadelphia,<sup>1</sup> Lakeside Hospital, Cleveland,<sup>7</sup> and Free Hospital for Women, Brookline,<sup>8</sup> show percentages of "cures"

varying from 30 to 62 per cent. Accurate comparison of these figures is not possible as they were compiled on somewhat different bases. It is to be re-



FIG 9—Papillary adenocarcinoma of the body of the uterus associated with diffuse adenomyoma. Total hysterectomy in 1916 patient living and well in 1925 (Case W S 212268, Spec 16-12-63)

gretted that the excellent formula for reporting results of operations for cancer advocated by Doctor Greenough<sup>9</sup> and approved by the American College of Surgeons has not been more universally adopted. The end results in this series of cases show 63 per cent of three-year "cures" and 66 per cent of five-year "cures" as set forth in Table I. This anomalous result illustrates the inconsistencies of statistics based on small numbers. It is however doubtless truer of carcinoma of the body of the uterus than perhaps of carcinoma of any other organ, that if recurrence takes place at all it occurs early.



## CONCLUSIONS

1 In adenocarcinoma of the body of the uterus there seem to be some striking exceptions to the theory of the relation of cellular differentiation to malignancy

2 Carcinoma of the body of the uterus is of relatively slow progression. It occurs at about the time of the menopause. After the establishment of the menopause the clinical diagnosis is usually quite obvious, before then it is often very obscure.

3 Diagnostic curettage should be resorted to in all doubtful cases.

4 Curettage followed shortly by hysterectomy does not seem to cause dissemination of the growth.

5 The frequent association of adenocarcinoma with myoma makes it imperative to perform preliminary diagnostic curettage whenever a supra-vaginal hysterectomy is contemplated.

6 Total abdominal hysterectomy is the operation of choice.

7 The operability rate and the results of operative treatment are such as to warrant a continuance of this form of treatment.

TABLE I  
*Carcinoma of Body of Uterus*  
End Results

A Total number of cases 1914-1925	50
B Reentries	0
C Recurrence from previous operation	0
D Cases available for study of operability, mortality, etc	50
E Radical operation (hysterectomy)	42
F Palliative operation (exploratory laparotomy)	3
G No operation (curettage only)	5
H Operative deaths (radical operation)	4
I Operative mortality	9.5%
J Operability (radical operation)	84%
K Operability (all operations)	
L Inconclusive cases, pathological examination of extirpated uterus failed to show carcinoma	2
M Inconclusive cases (untraced)	0
N Inconclusive cases, died within time limit without recurrence	1
O Remaining cases available for three-year end-result data (entries previous to May, 1922)	36
P Radical operations	30
Q Palliative operations (exploratory laparotomy)	3
R No operations (curettage only)	3
S Number of cases alive and well—three years	18
T Number of cases died after three years without recurrence	1
U Number of three-year "cures" all operations	19
V Number of three-year "cures" radical operations	19
W Percentage of three-year "cures" all operations	52%
X Percentage of three-year "cures" radical operations	63%
Y Number of five-year "cures"	14
Z Percentage of five-year "cures"	66%

# CARCINOMA OF THE BODY OF THE UTERUS

## REFERENCES

- <sup>1</sup> Norris, C C Carcinoma of the Body of the Uterus, with the Report of 115 Cases  
Am Journal Obstetrics and Gynæcology, vol vii, p 550
- <sup>2</sup> Ewing, J Neoplastic Diseases Second edition, p 551
- <sup>3</sup> McCarty, W C A Biological Conception of Neoplasia Am Journal Medical Sciences  
1919, vol clvii, p 657
- <sup>4</sup> Bioders, A C Squamous-cell Epithelioma of the Lip Journal American Medical  
Association, 1920, vol lxxiv, p 656
- <sup>5</sup> Mahle, A E Morphological Histology of Adenocarcinoma of the Body of the Uterus  
in Relation to Longevity Surg, Gyn and Obst, 1923, vol xxxvi, p 385
- <sup>6</sup> Davis, Lincoln Carcinoma of the Cervical Stump Boston Medical and Surgical  
Journal, vol clxxxviii, March, 1923, p 304
- <sup>7</sup> Cule, G W Carcinoma of the Uterus Am Journal Obstetrics and Gynæcology, vol  
vii, p 528
- <sup>8</sup> Meigs, J V A Study of Adenocarcinoma of the Fundus of the Uterus Am Journal  
Obstetrics and Gynæcology, vol iv, No 3, September, 1922
- <sup>9</sup> Greenough, R B, and Simmons, C C End-results in Cancer Cases Boston Medical  
and Surgical Journal, September, 1921

# METASTATIC CARCINOMA IN THE URETER

ASSOCIATED WITH URETERAL STRICTURE

By WILLIAM JAMES CARSON, M.D.

OF BALTIMORE, MD

FROM THE DEPARTMENT OF PATHOLOGY OF THE UNIVERSITY OF MARYLAND

CARCINOMATOUS deposits from primary tumors in the pelvis are frequently found in the lymph-nodes along the iliac vessels and abdominal aorta, while metastasis to bone is of common occurrence, in a large number of reported cases, secondary nodules have been found in the lungs and liver, and in not a few instances metastasis has been noted in the kidney. With the lymphatics of the ureters communicating with those of the bladder, it is singular that the ureters escape the invasion of carcinomatous cells derived from uterus, prostate, or bladder. Garceau,<sup>1</sup> in 1909, was able to collect from the literature 13 cases of metastatic carcinoma in the ureter due to extension by continuity.

Owing to the fact that the writer can find but two cases in the literature giving metastasis to the ureter through lymphatic or blood stream, the following cases are reported.

**CASE I**—R. K., colored male, aged forty-seven years, admitted to University Hospital on September 19, 1922, and died on January 23, 1923.

*Past History*—Frequent attacks of tonsillitis, acute colds and rhinitis, rheumatic fever eight years ago, duration two months. At this time the wrist, elbow and shoulder-joints were swollen, red and painful.

*Present Illness*—In the fall of 1920 patient developed an infection of the genito-urinary tract, which commenced with a thin watery discharge followed by a purulent discharge for three weeks. The condition cleared up, but returned again at the end of one week, during this interval the patient suffered from no disability of any kind. A thin watery discharge appeared—nocturia every two hours during the night. On micturition pain over lower abdomen, which radiated down the extremities. First admission to hospital March 8, 1922, service of Dr. W. H. Toulson.

Cystoscopic examination revealed a carcinoma of the left wall of bladder. A suprapubic cystotomy was performed for cauterization of mass and radium implantation. Discharged June 26, 1922, improved. At the time of second admission to hospital, he complained of pain in the abdomen, thighs, legs and joints, with burning on urination. On October 23 a suprapubic urinary fistula appeared, discharging pus and urine.

*Laboratory Findings*—Urine—repeated examinations showed specific gravity to vary between 1.010 and 1.015, albumin four plus, no sugar, large number of white blood cells and red blood cells, no casts. Average amount in 24 hours, 800 cc.

*Blood Picture*—Red blood cells, 3,000,000, leucocytes, 12,000, hemoglobin, 60 per cent (Talquist). Wassermann, negative.

*Blood Chemistry*—Non-protein nitrogen 40 mgms., urea, 21 mgms., sugar, 100 mgms.

*Autopsy No. 990—Genito-urinary Organs* (Fig. 1)—Kidneys—Left—11.5 by 3.8 by 6 cm. Right—13 by 8 by 5 cm. The capsules strip with increased resistance, leaving an irregular surface, with numerous elevated nodules, which fluctuate. Several of these are torn open by stripping off the capsule, and they show a thick greenish-yellow exudate.

## METASTATIC CARCINOMA IN THE URETER

within. On section all line markings are lost, and numerous cavities varying from 2 mm to 10 mm are seen, they contain a thick greenish-yellow exudate. The pelves and major and minor calices are dilated and filled with the same type of exudate.

*Left Ureter*—24 cm in length—varies in diameter from 6 to 26 mm and



FIG. 1.—Case I. Kidneys, ureters and bladder.

shows its serous surface to be smooth and glistening. There is a kink 5 cm below the uretero-pelvic junction with a band of adhesions extending from the lower pole of the kidney over the anterior surface of this kink. On section the wall varies from 1 to 2 mm in thickness. There is a stricture located 5 cm below the uretero-pelvic junction which extends from the inner side across the lumen of the ureter for 8 mm. One cm

below this a second stricture is seen extending from the outer wall toward the midline for a distance of 5 mm, which gives the lumen an S-shaped curve

A tumor mass is seen 16 cm below the uretero-pelvic junction, it is confined to the muscular wall and causes a narrowing of the lumen at this point

A third inflammatory stricture is seen 4 cm above the uretero-vesical orifice. The mucosa is of a yellowish-gray color and shows the vessels markedly distended by blood. There are two small soft calculi in the uretero-vesical orifice.

*Right Ureter*—24.5 cm in length—varies in diameter from 6 to 24 mm. Its serous surface is smooth and glistening. On section the wall is seen to vary in thickness

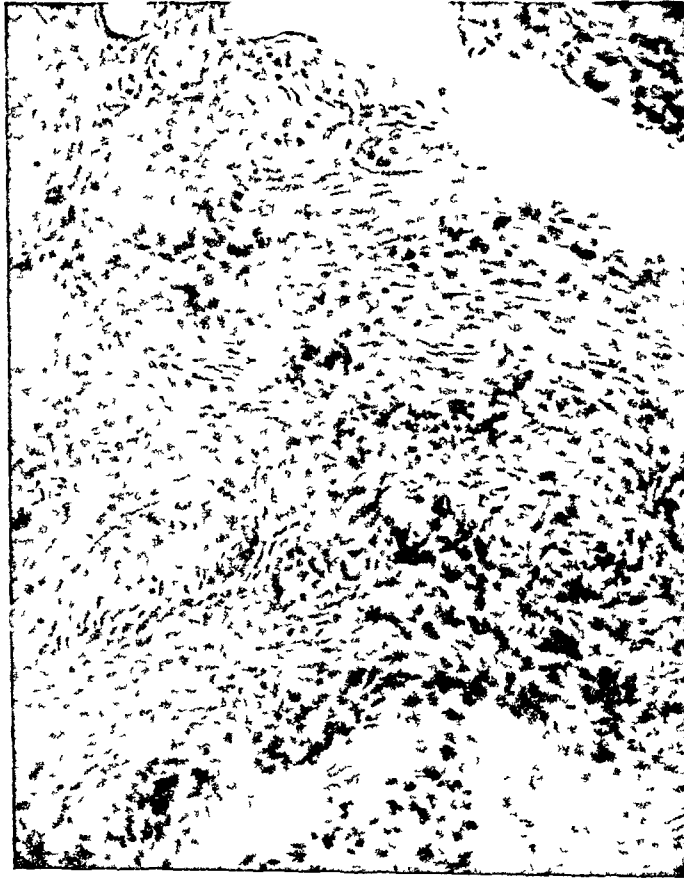


FIG. 2—Case I. Microphotograph of tumor in left ureter 16 cm down.

from 1 to 2 mm. At a point 6 cm below the uretero-pelvic junction, a stricture is seen extending from the outer wall toward the midline for a distance of 7 mm. A second stricture is seen 5 mm lower down, which extends from the inner side toward the outer wall for a distance of 5 mm, causing an S-shaped curve in the lumen of the ureter.

A tumor mass is seen in the muscular wall 10 cm below the uretero-pelvic junction, which constricts the lumen to 1 mm in diameter. The mucosa is of a yellowish-gray color and shows the vessels of the tunica propria to be markedly distended by blood.

*Bladder*—The wall on the left side and fundus measures 25 cm; on the right side, 1 cm in thickness. The mucosa is visible on the right side, the remaining portion showing a rough ulcerating surface. The trigon is of a dark red color, with the ureteral orifices measuring 1 mm. The vesical orifice is grayish-red in color, and the mucosa cannot be made out.

*Prostate*—The prostate is small, firm in consistency, nodular, and on section it is of a yellowish-gray color.

The testes, epididymes, vasa deferentia, and seminal vesicles show no noteworthy changes.

*Anatomical Diagnosis*—Carcinoma of the bladder, with metastases to the prostate, ureters, mesenteric lymph-nodes, lumbar vertebra, and liver. Ureteral stricture, bilateral, left 3, right 2. Multiple calculi in the left uretero-vesical orifice, hydro-ureters, bilateral, hydronephrosis, bilateral, pyonephrosis, bilateral, adhesions between the lower poles of kidneys and ureters, with kinks in the ureters.

*Microscopic Notes* *Bladder*—Section from the wall shows a mass of fibrous connective tissue, which is infiltrated by large epithelial cells arranged in a disorderly fashion, many of which show mitotic figures. In some areas it is very poorly stained, so

## METASTATIC CARCINOMA IN THE URETER

that no cell outline can be made out. The layers of the bladder are not visible in any part of the section.

*Left Ureter*—(16 cm down) Fig 2. The muscular wall shows the muscle fibres and connective-tissue cells for the most part poorly stained, with a large number of epithelial cells, which are well stained, infiltrating in a disorderly fashion through the wall. Many of these cells show mitotic cell division. Three blood-vessels show their perivascular lymph-spaces filled with epithelial cells with clear cytoplasm and hyperchromatic nuclei. In the tunica propria, small round cells and polymorphonuclears are seen. The mucosa shows the transitional epithelial cells well preserved for one-half the circumference of the lumen.

*Right Ureter* (10 cm down), Fig 3—consists of a mass of poorly stained muscle fibres and connective-tissue cells which are replaced in areas by epithelial cells, in other areas epithelial cells are seen infiltrating in a disorderly fashion. Many of these cells show mitotic figures. Several blood-vessels show their perivascular lymphatics filled with the same type of tumor cells. The mucosa is absent.

*Ureteral Strictures*—Sections from each show the muscular layer thickened due to an increase of connective-tissue cells between the muscle fibres. This is most pronounced in the inner half of the muscular layer and through the tunica propria. There is a marked infiltration of polymorphonuclears, mononuclear wandering cells and small round cells, with a few plasma cells.

The mucosa shows the transitional epithelial cells well preserved in one area, in the remaining portion of the sections they are absent.

*CASE II*—W. M., a white male, aged sixty-four years, admitted to Bay View Hospital, Medical Service, on June 24, 1924, with a history of having been treated at the Johns Hopkins Hospital for carcinoma of the prostate. Diagnosis on admission: Carcinoma of prostate, with metastasis to spine, empyema, right, cystitis, secondary anaemia.

The course in hospital was gradually downhill and patient died on July 2, 1924.

*Autopsy No 2574—Genito-urinary Organs* (Fig 4)—*Left kidney* 13.5 by 7 by 3.5 cm. Weight, 230 grams. The capsule strips with resistance, leaving a finely granular surface. On section the cortex is seen to vary from 4 to 8 mm in thickness, with the striated lines in the cortex and pyramids indistinct in outline. The pelves and major and minor calices show a marked dilatation with their lining mucosa of a dark reddish color.

*Right Kidney*—13 by 6 by 2.2 cm. Weight 180 grams. The capsule strips off with

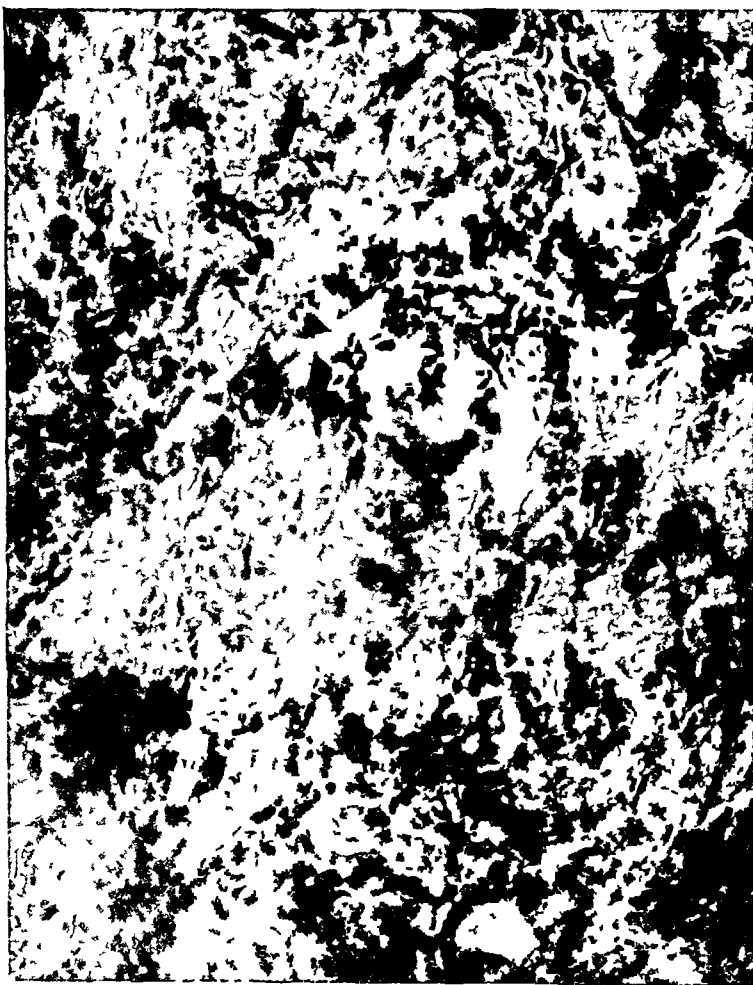


FIG 3 —Case I. Microphotograph of tumor in right ureter, 10 cm down.

resistance, leaving a pale granular surface. On section a large amount of fluid escapes. The cut surface shows the kidney substance to be reduced to a mere shell measuring from 4 to 8 mm in thickness. The pelves—major and minor calices—are markedly dilated to form one large cavity. In the upper pole there is a tumor mass 3 cm in

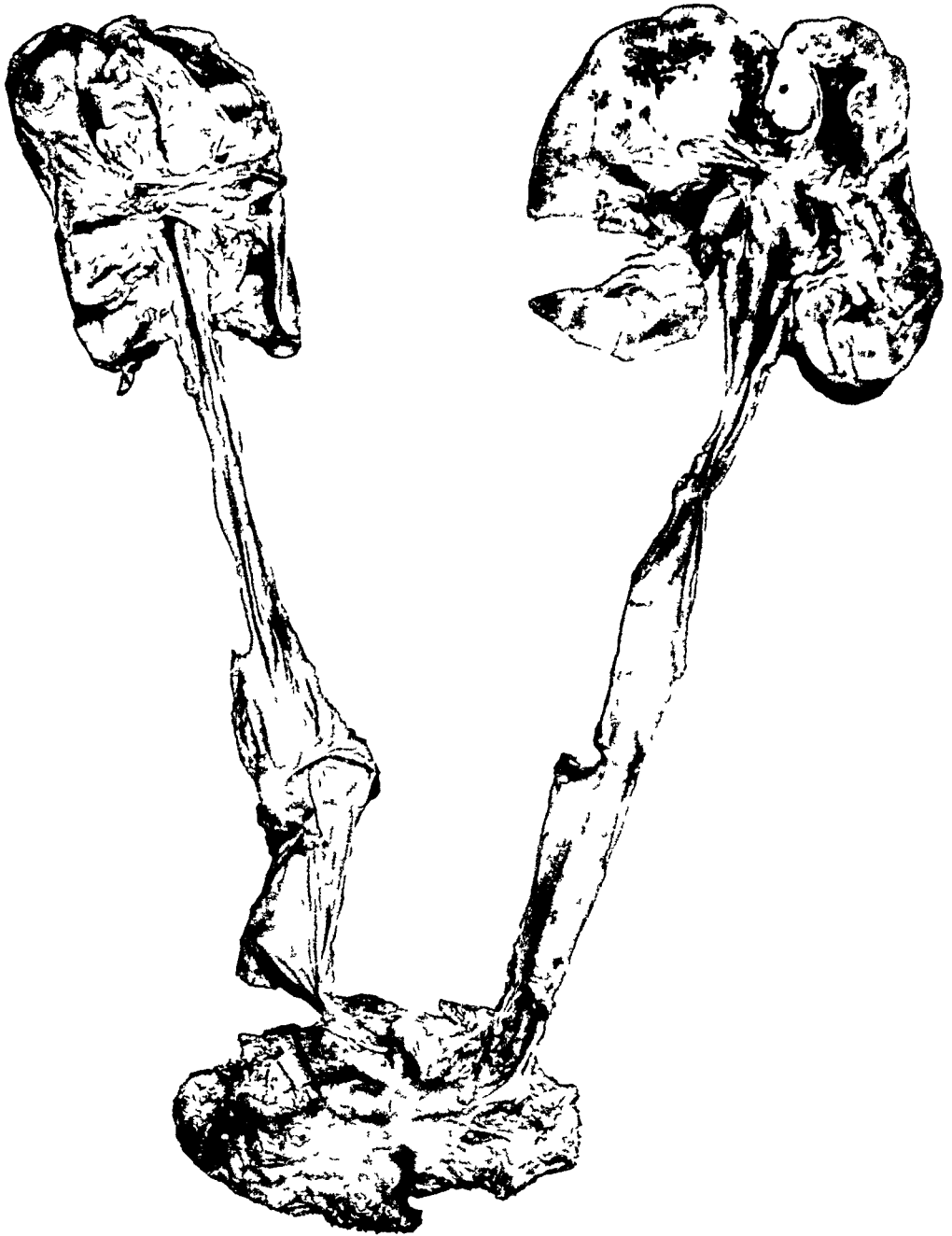


FIG 4—Case II Kidneys ureters bladder prostate and seminal vesicles

diameter which extends from the pelvis to the cortical portion, it is composed of a number of grayish nodules.

*Left Ureter*—28 cm in length—shows a marked dilatation from the bladder wall to kidney pelvis. On section the wall varies in thickness from 3 mm to 6 mm. There

## METASTATIC CARCINOMA IN THE URETER

is a stricture 4 cm below the uretero-pelvic junction, composed of scar tissue, a second stricture is seen 4 cm above the uretero-vesical orifice, which is composed of scar tissue of the same appearance as the one above

*Right Ureter*—28 cm in length—shows a marked dilatation from bladder wall to kidney pelvis. On section the wall varies in thickness from 2 to 4 mm. There is a tumor mass 15 cm below the uretero-pelvic junction, which is composed of a number of small grayish-white nodules, varying in size from 4 to 6 mm. This tumor mass involves the serous, muscular and mucous layers of the ureter. There is a stricture 3 cm above the tumor mass, which is composed of scar tissue and extends two-thirds around the circumference and measures 3 mm in thickness—10 mm in depth.

*Bladder*—The wall varies in thickness from 1 to 3.2 cm. The base and lateral walls are very firm in consistency and show numerous grayish-white nodules. The mucosa is of a grayish color, with the vessels markedly distended by blood. The right ureteral orifice cannot be seen. Upon opening the right ureter small nodules of a grayish-white color, measuring 1 to 2 mm in diameter, are seen in the intramural portion.

*Prostate* is moderately enlarged and very firm in consistency. On section it is seen to be replaced by a tumor of grayish-white color made up of a large number of small nodules. This tumor mass can be seen extending into the base and lateral walls of the bladder, seminal vesicles, and vasa deferentia, and measures 8 by 7 by 5 cm. The vasa deferentia external to the internal ring show no gross changes.

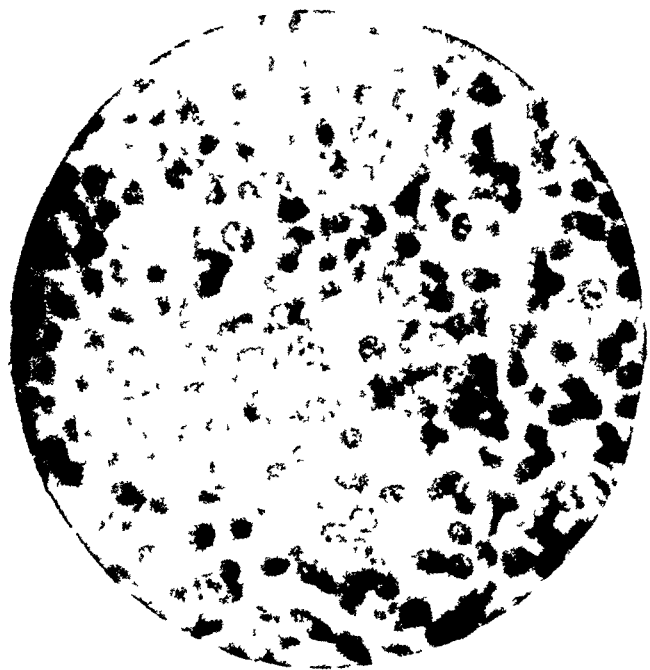


FIG 5—Case II. Microphotograph of tumor in right ureter, 15 cm down.

### *Anatomical Diagnosis—*

Adeno-carcinoma of the prostate with metastases to the bladder, seminal vesicles, vasa deferentia, right ureter, intramural portion and 15 cm below the uretero-pelvic junction, right kidney, lungs fifth lumbar vertebra, lymph-nodes along the external surface of ureters, iliac vessels, abdominal and thoracic aorta, ureteral strictures, bilateral, hydronephrosis, bilateral, ureteritis, left, chronic diffuse nephritis.

*Microscopical Notes. Prostate*—Sections from various parts of the gland show the alveoli to vary in size, and their lining epithelial cells vary from large clear columnar cells to small granular acidophile cells. A large number of the epithelial cells have hyperchromatic nuclei, a moderate number show mitotic cell division. In many areas these epithelial cells are seen breaking away from their basement membrane and infiltrating in a disorderly fashion through the connective tissue.

*Bladder*—The muscular wall shows a large number of epithelial cells arranged as alveoli or in a disorderly fashion. These cells have hyperchromatic nuclei and a moderate number show mitotic cell division. Many of these cells are seen breaking away from their basement membrane. In this area the muscle fibres are absent or poorly stained; in a few areas the muscle fibres are well stained. The mucosa is absent in most areas. In one area the transitional epithelial cells are deeply stained, and there is a marked small round-cell infiltration in the submucosa.



Sections taken from the seminal vesicles and terminal 3 cm of the vasa deferentia show them to be completely replaced by the tumor mass

*Ureter—Right*—15 cm down (Fig 5) shows the serosa to be infiltrated with epithelial cells, which have a clear cytoplasm and hyperchromatic nuclei. A few show mitotic division. The muscular layer is replaced by a tumor mass, which shows the same type of cells arranged as small alveoli or in a disorderly fashion. A large number of the cells have mitotic figures. At the edge of the tumor mass the epithelial cells can be seen infiltrating between the muscle fibres. The mucosa is replaced by small deeply stained epithelial cells with hyperchromatic nuclei.

*Ureter—Right*—Stricture 3 cm above tumor shows a mass of connective-tissue fibres which are well stained with a few small round cells infiltrating between them. The blood-vessels are well preserved.

*Ureter—Left*—Stricture shows the muscle fibres to be poorly stained with an increased amount of connective tissue between the muscle fibres, with a marked infiltration of small round cells and a moderate number of mononuclears and polymorphonuclears.

*Kidney—Right*—Section from tumor mass (Fig 6) shows a large mass of well-stained epithelial cells with mitotic cell division which for the most part are arranged as alveoli or glandular acini. There are a few well-preserved adult blood-vessels within the tumor mass. The cortex of right kidney shows a marked thickening of the capsule due to well-stained adult connective-tissue fibres. The capsules of Bowman show a marked thickening due to connective-tissue fibres. A large number

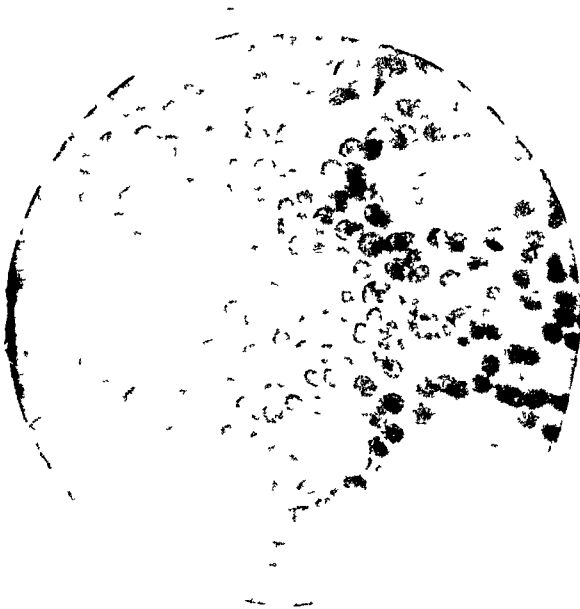


FIG 6—Case II Microphotograph of right kidney tumor

of tufts are replaced by poorly stained fibrous connective tissue, others are completely hyalinized. The remaining tufts show the epithelial and endothelial cells well preserved, with their vessel walls thickened. The tubules for the most part show their lining epithelial cells well preserved with hyaline casts within the lumen. A number of tubules are seen collapsed in scar tissue which is infiltrated in areas by small round cells and mononuclear wandering cells. The larger blood-vessels show a thickening of their tunica intima.

CASE III—S B, admitted to Surgical Service of Bay View Hospital on November 16, 1923, and died November 4, 1924.

*Past History*—Had childhood diseases, smallpox, typhoid, malaria, influenza and rheumatism. Had several hemorrhages from the vagina in the past two years, with a moderate loss of weight. Pain in lower abdomen for one month.

*Physical Examination*—Blood-pressure 185/85. Patient is a fairly well-developed, poorly nourished, anæmic looking colored woman. Marked dental caries. Trachea diverted to the right side. There are a few moist râles at both bases. The heart rate is irregular. The abdomen is slightly full, no pain on palpation, no rigidity, no masses.

*Vaginal Examination*—Moderate amount of pale reddish discharge. No ulceration or scarring of vulva. There are many small and firm painless nodules on the edges of the cervix and the anterior vaginal wall. The uterus is small, firm and painless.

## METASTATIC CARCINOMA IN THE URETER

*Laboratory Findings*—Urine—specific gravity 1.018, albumin 1 plus, sugar negative  
Microscopical—few granular casts Blood—Wassermann negative

*Impression*—Carcinoma of cervix uteri, with metastasis to anterior vaginal wall

### *Course in Hospital*—

Patient had a gradual downhill course. Repeated vaginal hemorrhages, one of which required packing. Incontinence of urine.

*Autopsy No 2651—Genito-urinary Organs* (Fig 7)—*Left kidney* weighs 150 grams and measures 11 by 6 by 3.5 cm. The capsule strips with moderate resistance, leaving a pale, smooth surface. On section the normal architecture is fairly well preserved. The pelves and calices are moderately dilated.

*Right kidney* weighs 60 grams and measures 11.8 by 4.2 by 2.5 cm. The capsule is removed with ease. On section the cortex and pyramids are seen to be markedly thinned out, the line markings being scarcely visible. The pelves and calices are markedly dilated.

*Left ureter* shows a moderate dilatation from 1 to 1.8 cm in diameter. On section the wall measures 1 to 2 mm in thickness. The mucosa is of a dark reddish color throughout.

*Right ureter* is markedly dilated. On section the wall varies in thickness from 2 to 3 mm. A stricture is seen 3 cm below the uretero-pelvic junction. A second stricture is located 13 cm down which constricts the lumen to 1 mm in diameter. There is a tumor mass in the muscular wall 15 cm below the uretero-pelvic junction which measures 7 by 10 mm. The



FIG 7—Case III Right kidney and ureter

ureter empties into the large cavity at which point it is surrounded by a tumor mass

*Pelvic Organs—Bladder.* The muscular wall is markedly thickened, measuring from 8 to 12 mm. On the posterior wall there is a large opening which communicates with the vagina. The edges of this fistula tract are ulcerated in appearance. The mucosa is covered over with a grayish necrotic diphtheritic membrane.

The vagina is large, with the wall covered by a layer of grayish necrotic material. It is seen to open into a huge cavity which communicates with the bladder anteriorly and with the rectum posteriorly.

The cervix and lower half of the body of the uterus has been destroyed by ulceration. The wall of this cavity is of a dark grayish-yellow color, irregular in outline. Numerous



FIG 8—Case III. Microphotograph of right ureter, 15 cm. down.

right ureteral wall 15 cm. from pelvis; liver, fistula, recto-vaginal and vesico-vaginal, ureteral strictures right (3 and 13 cm. down), hydro-ureters bilateral, hydronephrosis, bilateral, arteriosclerosis, chronic diffuse nephritis.

*Microscopical Notes—Uterus.* Section taken from ulcerating area shows a large mass of epithelial cells arranged in clumps which are poorly stained. Several pearls are seen. The tumor cells are distinctly squamous in type and show mitotic cell division, with numerous ones containing hyperchromatic nuclei.

*Ureter—Right* (13 cm. down) shows the muscular wall to be covered with a single layer of mesothelial cells. There is a definite increase of connective-tissue cells between the muscle cells, replacing them in other areas next to the tunica propria. Throughout the muscular and tunica propria layers small round cells and mononuclears are seen. The mucosa shows the transitional epithelial cells well preserved.

*Ureter—Right.* Tumor mass (15 cm. down), Fig 8, is surrounded by a capsule of

small tumor nodules are visible. At the upper part of this cavity the fundus of the uterus can be made out. Loops of ileum are adherent to this cavity wall, walling it off from the peritoneal cavity. In the wall of the ileum a tumor nodule can be made out. Ulceration has extended on the right side to the ureter so that it empties directly into the cavity. There is a large necrotic sloughing mass behind the levator ani.

The tubes and ovaries are so obscured by the large mass of adhesions that they cannot be identified.

*Anatomical Diagnosis—* Squamous-cell carcinoma of cervix which has extended into the body of the uterus, posterior wall of the bladder, anterior wall of the rectum, distal end of right ureter and wall of ileum, metastatic nodules in iliac and mesenteric lymph-nodes,

## METASTATIC CARCINOMA IN THE URETER

poorly stained connective tissue, which contains a few blood-vessels. The section shows the muscle fibres in a few areas to be fairly well preserved, with a few squamous epithelial cells infiltrating between them. In other areas epithelial cells are seen massed together, most of which have a clear cytoplasm and hyperchromatic nuclei, with a moderate number showing mitotic cell division. Several epithelial pearls are seen. The larger blood-vessels show a perivascular infiltration of small round cells and mononuclear wandering cells. Several nerve bundles are seen well stained. There are two blood-vessels, the perivascular lymphatics of which contain epithelial cells. These cells are the same in appearance as the tumor cells seen elsewhere. The mucosa is absent.

*Discussion*—Langstaff,<sup>4</sup> Tanchau,<sup>5</sup> Gross,<sup>6</sup> Adams,<sup>7</sup> Thompson,<sup>8</sup> von Recklinghausen,<sup>9</sup> Cone,<sup>10</sup> Blumer,<sup>11</sup> Bumpus,<sup>12</sup> Kaufmann,<sup>13</sup> Young,<sup>14</sup> and others have reported the findings of secondary deposits from prostatic cancer, with a few cases showing sufficient infiltration into the bladder wall to obstruct the uretero-vesical orifice.

Giordano and Bumpus<sup>2</sup> reported a case of carcinoma in the uretero-pelvic junction, metastatic from the prostate, with the peri-ureteral lymph-nodes involved, and microscopic examination showed cancer cells in blood-vessels of the kidney nodule.

Thomas and Regnier<sup>3</sup> reported a case of cancer of the bladder with metastases to the lymph-nodes, psoas muscle, and right ureter, the muscular wall in the mid-portion being involved.

Cullen<sup>15</sup> shows excellent photographs of cancer of the cervix ulcerating through the lower end of the ureter as occurred in Case III, but makes no mention of metastatic nodules in the ureteral wall, the result of lymphatic metastasis.

Ewing<sup>16</sup> describes papillary tumors of the bladder extending into the lumen of the ureter or invading from the vesical wall, and primary tumors of the kidney pelvis extending down the ureter. In prostatic cancer Ewing states that the ureters are invaded from the vesical wall as in bladder carcinoma, or occluded by nodules at the orifice, or compressed by enlarged lymph-nodes.

In the above cases the tumor cells were found in the peri-vascular lymphatics of the ureters. Metastasis by blood is responsible for the nodules found in the liver and lumbar vertebra in Case I, lungs and vertebra in Case II, and liver in Case III.

The ureteral strictures—Case I, three in the left, two in the right, Case II—two in the left, one in the right, Case III, two in the right are essentially the same as those described by Hunner,<sup>17, 18</sup> Carson<sup>19</sup>

### CONCLUSIONS

- (1) Three cases of metastatic carcinoma in the ureter are reported.
- (2) From the bladder in Case I, prostate in Case II, and cervix uteri in Case III.
- (3) In each case the cancer cells were found in the perivascular lymphatics of the ureter.
- (4) Ureteral strictures inflammatory in origin were found in each case.

WILLIAM JAMES CARSON

I am indebted to Professor Hugh R. Spencer for the privilege of reporting these cases

BIBLIOGRAPHY

- <sup>1</sup> Garceau, E. Tumors of the Kidney, 1909
- <sup>2</sup> Giordano, A. S., and Bumpus, H. C. Journal of Urology, 1922, vol. VIII, p. 445
- <sup>3</sup> Thomas, G. J., and Regnier, E. A. Journal of Urology, 1924, vol. XI, p. 205
- <sup>4</sup> Langstaff, G. Trans. of Med. Chir. Society, 1817, vol. VIII, p. 279  
Tanchau. Recherches sur le Traitement medical des Tumeurs Cancereuses du Sein, Paris, 1844
- <sup>5</sup> Gross, S. D. Urinary Organs, 1851  
Adams, J. The Lancet, 1853, vol. I, p. 393
- <sup>6</sup> Thompson, H. Trans. Pathological Society, London, 1854, vol. V, p. 204
- <sup>7</sup> von Recklinghausen. Über ostitis, osteo-malacia und osteoplastisches carcinoma. Festschrift zu Virchow's, 71, Geburtstag, Berlin, 1891
- <sup>8</sup> Cone, S. M. Bulletin Johns Hopkins Hospital, 1898, vol. IX, p. 114
- <sup>9</sup> Blumer, G. Bulletin Johns Hopkins Hospital, 1909, vol. XX, p. 200
- <sup>10</sup> Bumpus, H. C. Surgery, Gynecology and Obstetrics, 1921, vol. XXXII, p. 31
- <sup>11</sup> Kaufmann, E. Über carcinome der prostata. Cor. Bl. F. Schweiz. Aertze Basel, 1902, vol. XXXII, p. 757
- <sup>12</sup> Young, H. H. ANNALS OF SURGERY, 1909, vol. I, p. 144
- <sup>13</sup> Cullen, T. S. Cancer of the Uterus, 1909
- <sup>14</sup> Ewing, J. Neoplastic Diseases, 1922
- <sup>15</sup> Hunner, G. L. Bulletin Johns Hopkins Hospital, 1918, vol. XXIX, p. 1
- <sup>16</sup> Hunner, G. L. Modern Urology, 1924, vol. II
- <sup>17</sup> Carson, W. J. Urologic and Cutaneous Review, 1924, vol. XXXIII, p. 386

# PRIMARY CARCINOMA OF THE DUODENUM\*

REPORT OF FIFTEEN VERIFIED CASES

BY GEORGE B EUSTERMAN, M D

AND

DAVID M BERKMAN, M D

SECTIONS ON MEDICINE, MAYO CLINIC

AND

THEODORE S SWAN, M D

FELLOW IN SURGERY, THE MAYO FOUNDATION

OF ROCHESTER, MINN

A FAIRLY extensive review of the literature on the subject of primary carcinoma of the duodenum seems to show that there are comparatively few carcinomas of the small intestine, comprising only about 3 per cent of those of the entire intestinal tract, and that the duodenum is usually affected more often than the jejunum or ileum. Surgical and necropsy records in the Mayo Clinic show the opposite to be true, there being fifteen cases of primary carcinoma of the jejunum, and nine of the ileum, making a total of twenty-four in contrast to fifteen of the duodenum. This difference may be accounted for partly by the fact that some of the cases of duodenal carcinoma reported in the literature are, as recent pathologic studies have shown, extensions from carcinoma of the pylorus.

Approximately 66 per cent of carcinomas of the duodenum occur in the second or ampullary portion, 22 and 12 per cent, respectively, occur in the first, or supra-ampullary, and third, or infra-ampullary portions. In the Mayo Clinic series, six were in the ampullary portion, six in the supra-ampullary, and three in the infra-ampullary.

In the reported cases there were considerably more males than females, and the average age was fifty-two years. In our series twelve of the fifteen patients were males and the average age was fifty-six years. Half of the patients were in the fifth decade of life, only three were in the fourth. The youngest patient was thirty-nine, and the oldest seventy.

*Symptoms*—The clinical picture, according to many earlier, as well as later, writers, depends on the location of the growth. Thus with carcinoma of the first or supra-ampullary portion of the duodenum, the symptoms common to carcinoma or obstruction of the pylorus are simulated. Involvement of the ampullary portion is supposed to give rise to an obstructive form of jaundice with its sequelæ often to infectious processes in the bile ducts, or abscesses in the liver, so that the picture can hardly be distinguished from that of carcinoma of the head of the pancreas, bile ducts or ampulla. Deaver and Ravdin modify the traditional description somewhat by asserting that jaundice, under the circumstances, is a constant and persistent symptom.

---

\* Read before the American Gastro-entcological Association May 25, 1925

although not so severe as with carcinoma of the ampulla, that with carcinoma of the third or infra-ampullary portion the symptoms are those common to malignant pyloric obstruction except that invariably there is no palpable mass, and the vomitus is much more profuse and contains bile and pancreatic juice. There are, also, the systemic changes that result from obstruction and the loss of a great deal of fluid. Certain observers have also noted the presence of free hydrochloric acid in the gastric contents. The latter, however, is of no differential diagnostic significance, as free hydrochloric acid may be present in cases of obstructing pyloric cancer. In all varieties the symptoms are chiefly gastric and are those usually associated with carcinoma of the pylorus, although often less pronounced. Until recently the diagnosis has been rarely made during life, or before operation and even with the aid of Röntgen-ray examination it is often very difficult to recognize the disease.

*Clinical Symptoms* †—In the series of fifteen cases the mode of onset was recorded as gradual in seven, and as sudden in eight. The initial symptom in seven was pain, usually epigastric and moderate in degree. In only two cases (Table II, Cases VI and VII) was it both severe and sudden and an outstanding feature throughout the complaint. In the remainder the initial symptom was that of a moderately reversed peristalsis, or retention, ranging from flatulency and its accompanying subjective sensations to vomiting of the obstructive type. In eleven cases the pain was a prominent primary or secondary feature. In three the pain was negligible or absent. In ten cases the pain appeared from one to four hours after meals, usually two to three hours afterward. Vomiting, which was a common symptom, usually afforded relief. Two patients obtained relief by taking alkalis. In the majority of cases, therefore, the syndrome of duodenal ulcer was apparent, but the onset of the disease in later adult life, its rapidly progressive character as a rule, the presence of marked pyloric obstruction and the frequent subacid or anacid gastric contents, and finally the general appearance of the patient, implied that we were dealing with a more serious process. The average duration of symptoms at the time the patients presented themselves for examination was six and one-third months. Two had had symptoms for only seven weeks, yet both had advanced duodenal obstruction. One patient (Table II, Case XI) had had symptoms for about fourteen months, the longest in our series. He also had advanced duodenal obstruction and at operation a hard, movable mass was found from 6 to 8 cm. below the pylorus, encircling the duodenum. Somewhat to our surprise the patient was still alive thirteen months after a posterior gastro-enterostomy had been performed. The average duration of life in the entire series was thirteen and thirty-six hundredths months. The average duration of life, as recorded in the literature, is about

---

† The clinical records are fairly complete in fourteen of the fifteen cases. The one exception was a necropsy case (Table II, Case IV), in which there was a carcinoma of the duodenum, apparently having its inception in an old scar of a duodenal ulcer, but with an independent associated carcinoma of the pancreas, symptoms were chiefly due to the latter.

# PRIMARY CARCINOMA OF THE DUODENUM

seven months, the extremes ranging from three to eighteen months. Flatus, characterized by bloating, belching, and a sense of epigastric fullness, the latter often provoking distress, pain as previously noted, nausea and vomiting, usually of the retention type, and relief by vomiting, were the chief symptoms common to all the patients. Weakness, thirst, dehydration, toxæmia, and marked loss of weight and strength were symptoms in the cases of advanced obstruction. With few exceptions the clinical course was quite progressive, which is to be expected in view of the rather short average duration of the disease. Jaundice, in our cases, contrary to those recorded in the

TABLE I  
Case A498518 Duodenal Toxæmia of Carcinoma

Intake c c					Output c c				Blood chemistry				Blood pressure		
Date 1925	Proctoclysis	Subcutaneous	Intravenous glucose 10% NaCl 1%	Mouth	Total	Total	Emesis	Lavage	Urine	Urea	Chlorids	Carbon dioxide combining power	Hæmoglobin, per cent	Systolic	Diastolic
3-10	On Admission									60	310	121.5	80	90	66
3-11	1300	0	2000	1780	5080	4210	1000	2050	1160	36	350	124.1	79	95	70
3-12	1000	0	2000	0	3000	2210	400	625	1175	26	380	113.8		98	70
3-13	2500	0	2000	90*	5590	2325	0	1025	1300	26	450	103.4	70	90	60
3-14	2500	0		90*	2590	2325	0	1625	700	28	450	105.2	63	95	65
3-15	1500	0	1000	90†	2590	3600	0	2350	450					95	65
3-16	1000	0	3000	90‡	4090	3200	0	1600	600	22	460	94.8	65	95	55
3-17	Operation—posterior gastro-enterostomy														
3-17										20	540	83.0			
3-18										45	500	82.0			
3-19										39	500	68.0			
3-20										24	460	63.0			

\*Belladonna

literature, was conspicuous by its absence with carcinoma of the ampullary portion, at least while the patients were under observation. However, it is reasonable to suppose that obstructive jaundice was one of the prominent terminal conditions, and probably the actual cause of death. The fact that the seriousness of jaundice in the second group is so strongly stressed by other writers leads us to believe that the patients were seen in an advanced stage, or that the carcinoma had its origin in the ampulla itself or in the terminal portion of the common duct. Carcinoma of the head of the pancreas occasionally involves the duodenum sufficiently to produce obstruction thus confusing the diagnosis.



TABLE II  
*Summary of Cases*

Case	Symptoms	Examination	Laboratory data	Operation	Results
1	Indigestion ten years. Recent trouble, gradual, seven weeks' duration. Dull epigastric pain one hour after meals. Distress and pyrosis. No vomiting.	Cachexia. Right epigastric tumor, small, nodular, movable. Lost 2 pounds in weight.	Total acids 94, free hydrochloric 0, lactic 2, blood 2, food remnants 4. Rontgenograms not made.	Operation, June 12, 1920. Carcinoma of duodenum, extending up to pylorus, with obstruction. Anterior gastro-enterostomy.	Died three months after operation.
2	Gradual onset one year previously. Flatulency, also epigastric pain two hours after meals. Vomiting of retention type. Progressively worse.	Pallor. Tumor of right epigastrium. Visible peristalsis. Weight loss, 40 pounds.	Total acids 36, free hydrochloric 8, lactic 2, blood 2, food remnants 3. Second examination total acids 24, free hydrochloric 0. Rontgenograms not made.	Operation, November 22, 1911. Carcinoma in pyloric end and lesser curvature of stomach. Primary malignant papilloma. Pylorus and duodenum resected. Mikulicz-Billroth No. 2, gastro-enterostomy.	Lived two years after operation.
3	Sudden onset twelve months before. Numbness in upper and lower extremities. Dyspnea on exertion. Spell of epigastric distress three hours after meals and at midnight. Flatulency and pyrosis. Suggestive retention type of vomiting.	Anemia. No tumor palpable. Loss in weight 13 pounds. On second examination ten months later, severe anemia and jaundice.	Hæmoglobin from 40 to 55 per cent. Erythrocytes, 280,000. Total acids 10, free hydrochloric 0, 20 c.c. of gastric contents. Rontgenogram indeterminate. Urinalysis normal. Ten months later hæmoglobin 22 per cent., erythrocytes, 1,790,000. Rontgenograms not made.	No operation. Died. Necropsy. Carcinoma of first portion of duodenum, involving head of pancreas, with partial occlusion of common bile duct.	No operation. Died. Necropsy. Carcinoma of head of pancreas with obliteration of ampulla, carcinoma of duodenum 2.5 cm in diameter, apparently arising in scar of healed duodenal ulcer.
4	Syndrome of primary carcinoma of head of pancreas.	Icterus. Fixed tumor to right of umbilicus. Emaciation. Loss of weight, 20 pounds.	Hæmoglobin from 60 to 70 per cent. Erythrocytes, 4,680,000. No gastric analysis. Coagulation time nine to eleven minutes. Rontgenograms not made.	No operation. Died. Necropsy. Carcinoma of head of pancreas with obliteration of ampulla, carcinoma of duodenum 2.5 cm in diameter, apparently arising in scar of healed duodenal ulcer.	No operation. Died. Necropsy. Carcinoma of head of pancreas with obliteration of ampulla, carcinoma of duodenum 2.5 cm in diameter, apparently arising in scar of healed duodenal ulcer.

# PRIMARY CARCINOMA OF THE DUODENUM

5	Gradual onset, eight months' duration Dull, gnawing pain in epigastrium, from two to four hours after meals Flatulency Relief by frequent and copious vomiting Constipation marked	Tenderness of right epigastrium Marked loss of weight and strength Loss of weight, 42 pounds	Hæmoglobin 75 per cent , erythrocytes, 4,800,000 Total acids 30 Free hydrochloric 0 Food remnant 400 c c Occult blood 1 Rontgenogram showed duodenal ulcer	Operation, September 15, 1917 Posterior gastroenterostomy	Duration of disease eight months Died Necropsy carcinoma of supra-ampullary portion of duodenum, with ulceration of mucosa
6	Sudden onset seven weeks before Severe epigastric pain Vomiting of retention type Rapidly progressive course	Moderate anemia Rigidity throughout epigastrium Loss of weight, 30 pounds	Hæmoglobin 75 per cent Erythrocytes 4,700,000 Total acids 58, free hydrochloric 10, 1127 c c of gastric contents Food remnant 3, blood 1 Rontgenogram showed lesion at outlet of stomach, retention +	Operation, April 22, 1920 Posterior gastroenterostomy Tumor situated 1 inch below the pylorus, rather fixed	Died nine months after operation Duration of disease about eleven months Terminal signs obstructive jaundice
7	Sudden onset three months before Attacks of flatulent epigastric distress, followed by severe pain This appears irregularly after meals, duration one to two hours, relief by vomiting, obstructive type	Anemia Malnutrition Movable and tender tumor just below umbilicus Lost 55 pounds in weight in two months	No test-meal or X-ray Urine showed a trace of albumin and a few hyaline casts	Operation, July, 1913 Contracting type of tumor in second portion of duodenum, 4 5 inches below pylorus Gastroenterostomy Primary operation performed eleven days before for pelvic tumor	Lived about eight months after operation
8	Sudden onset seven weeks before Severe pain in right upper quadrant Nausea, flatulency, vomiting of retention type Intermittent attacks, progressively more frequent Pain appears from two to three hours after meals Food case	Succession splash Lost 27 pounds in last year	Hæmoglobin 66 per cent Total acids 28, free hydrochloric 20, food remnant 1, 365 c c of gastric contents Rontgenogram was negative	Operation, February 17, 1919 Posterior gastroenterostomy Hard, nodular mass about 4 5 inches below pylorus, encircling duodenum just above ampulla, producing obstruction	Died one year after operation Duration of disease, two years Severe obstructive jaundice and dyspnoea developed prior to death

TABLE II—Continued  
Summary of Cases

Case	Symptoms	Examination	Laboratory data	Operation	Results
9	Duration of symptoms four months, sudden onset Aching pain in epigastrium from two to three hours after meals, flatulency, obstructive vomiting, Duodenal toxæmia and recent tetany	Moderate anemia, malnutrition, visible gastric peristalsis and succussion Tumor in lower right epigastrium, movable Acute nephritis Blood area, 120-124 mg Creatinin, 17 to 23 mg Albumin and casts in urine Loss of weight, 40 pounds	Hæmoglobin 76 per cent Erythrocytes 4,590,000 Total acids 26, free hydrochloric 14, 700 c c of gastric contents trace of blood, food remnant 1 Second test total acids 18, free hydrochloric 0, 750 c c of gastric contents Fasting contents total 10, free hydrochloric 0, 100 c c gastric contents Rontgenogram showed large gastric residue, gaping pylorus, distended duodenal cap, obstruction beyond	Operation, October 2, 1920 Apparent acute obstruction in duodenum about 8 cm below pylorus Hard mass involving head of pancreas Posterior gastro-enterostomy	Died two days after operation Necropsy primary carcinoma of duodenum with obstruction Bilateral broncho-pneumonia and acute diffuse nephritis
10	Duration five months No actual pain Flatulency, dull ache with epigastric fullness Gnawing sensation in epigastrium two to three hours after meals Emesis only once in spite of obstruction	Anemia No palpable mass Visible peristalsis Succussion splash Loss of weight, 8 pounds	Hæmoglobin 59 per cent Erythrocytes 3,600,000 Total acids 30 to 70, free hydrochloric 0, 790 c c of gastric contents Food remnant 3, occult blood 2 Rontgenogram showed large stomach, much secretion No demonstrable pathologic lesion	Operation, November, 1922 Carcinoma of duodenum at ampulla, causing obstruction	Lived eleven months after operation No knowledge of terminal symptoms
11	Gradual onset fourteen months before Gas, occasional slight pain in epigastrium Vomiting of retention type Loss of weight and strength	Fair color Malnutrition 3 Abdominal distention, visible gastric peristalsis Loss of weight, 50 pounds	Hæmoglobin 80 per cent Erythrocytes 4,610,000 Total acids 54, free hydrochloric 20, food remnant 2 Yeasts and Oppler-Boas Rontgenogram showed stomach and duodenum dilated 3 Blood chemistry of duodenal toxæmia	Operation, February, 1923 Obstruction of duodenum by hard, movable tumor, 6 by 5 by 5 cm, from 6 to 8 cm below pylorus Encircling type Posterior gastro-enterostomy Large dilated colon, much gas	Patient was alive eleven months after operation

# PRIMARY CARCINOMA OF THE DUODENUM

12	Sudden onset two months before Vomiting, gas, epigastric pain with nausea one or two hours after meals Later severe gastric tetany and duodenal toxæmia	Fair color Malnutrition Scaphoid abdomen Borygmus Visible peristalsis Toxic, dehydrated Chvostek and Trousseau positive Loss of weight, 50 pounds	Hæmoglobin 83 per cent Erythrocytes 4,090,000 Patient too ill and toxic for tubing or X-ray (See Table I for data on duodenal toxæmia)	Operation, March, 1925 Carcinoma in lower, second portion of duodenum, with marked obstruction Collapsed jejunum Posterior gastroenterostomy	Living Vomiting and bloating occasionally
13	Gradual onset two months before Belching, pyrosis and regurgitation followed in a week by emesis No pain Dull, heavy sensation in epigastrium	Color fair Malnutrition 1 Succussion splash Loss of weight, 10 pounds	Hæmoglobin 75 per cent Erythrocytes 4,600,000 Total acids 24, free hydrochloric 12, 1000 c c of gastric contents, food remnants 2, bile 2 Rontgenogram showed dilated stomach and duodenum Obstruction 6 inches below pylorus	Operation, November 24, 1920 Small, hard tumor at duodeno-jejunal angle, producing very marked obstruction Gastroenterostomy	Lived thirteen months after operation Obstructive jaundice and diarrhoea
14	Gradual onset nine months before Daring pain in epigastrium soon after meals Gas Later obstructive vomiting Progressive course	Cachexia Distention and tympany in upper abdomen Loss of weight, 50 pounds	Hæmoglobin 56 per cent Erythrocytes 3,500,000 Total acids 50, free hydrochloric 34, 100 c c of gastric contents Rontgenogram was negative	Operation, May, 1921 Exploration Abdominal carcinomatosis	Died two days after operation Necropsy carcinoma of terminal duodenum with metastasis to jejunum and ileum
15	Sudden onset of symptoms two months before Moderate epigastric pain, nausea and vomiting Progressive course	Moderate anemia Epigastric tenderness Loss of weight, 15 pounds	Hæmoglobin 69 per cent Erythrocytes 4,100,000 Total acids 8, free hydrochloric 0, 500 c c of gastric contents, food remnants 3 Rontgenogram showed operable gastric cancer, retention 2	Operation, February, 1921 Carcinoma involving terminal duodenum, with obstruction Duodenal jejunostomy	Died seven days after operation Necropsy carcinoma of duodenum, 20 cm from pyloric ring Lumen obstructed 3 Bilateral bronchopneumonia Diffuse fibrinous peritonitis

On physical examination a tumor was found in five (33.33 per cent) of the fifteen cases in the series. Three of the cases were in the group of six cases of carcinoma of the first, or supra-ampullary portion of the duodenum. The remaining two were in the second or ampullary group, which also consisted of six cases. In the first group of three cases the tumors were rather tender, somewhat mobile, firm, nodular, and moderate in size. No palpable mass was found in the third or infra-ampullary portion. An anemic, cachectic appearance was the rule. One patient (Table II, Case III) had a severe terminal anemia. Data concerning terminal symptoms and signs in patients who survived operation but who later died at their homes are very incomplete, but it is assumed that obstructive jaundice, inanition, toxæmia, anemia, extensive metastasis, infectious processes, intercurrent disease, or other complications were the culminating factors.

*Gastric Retention from Duodenal Obstruction*—There was clinical evidence of duodenal obstruction in twelve cases, consisting of a retention type of vomiting, marked succussion splash, and visible gastric peristalsis, the retention was readily confirmed by motor-meal tests. In two other cases (Table II, Cases III and XIV), there was no retention on first examination, but examinations four and nine months later, respectively, revealed marked obstruction and physical deterioration. Therefore, in only one case (Table II, Case IV) was there no duodenal obstruction with its associated phenomena. Gastric analyses were made in twelve cases. In two cases the precarious condition of the patient, largely on account of obstructive vomiting, did not permit gastric analysis or Röntgen-ray studies. In five of the twelve cases there was an absence of free hydrochloric acid. In the remaining seven free acid (from eight to thirty-four, in terms of tenth normal sodium hydroxide, with an average of seventeen) was present in the gastric content. In all but one case in which there was free hydrochloric acid there was also gastric retention. Positive occult blood reactions were obtained in most cases. In the infra-ampullary group the secretion was excessive and the gastric contents were colored a green or yellow by the presence of bile and pancreatic juice. There was no particular difference in the gastric chemistry and motor function in the various groups.

*Röntgen-ray Examination*—In three of the ten cases in which roentgenograms were made the findings were negative or indeterminate. In two of these the examination had been made before obstruction had developed. In one case (Table II, Case VIII), in which there was no barium residue after six hours, the Riegel meal revealed gastric retention after twelve hours. Dilated stomach, with moderate to marked retention, but without a demonstrable lesion in the stomach were the common findings and were occasionally diagnosed as operable lesions of the stomach. In two cases the demonstration of a large stomach, dilated duodenum and retention made an exact anatomic diagnosis possible by this procedure. Data of individual cases may be found in Table II.

## PRIMARY CARCINOMA OF THE DUODENUM

*Toxæmia from Duodenal Obstruction Treatment*—Toxæmia from duodenal obstruction is a serious complication because of its direct bearing on prognosis and surgical mortality. Clinically, toxæmia may be suspected when the vomiting is associated with, or followed by, evidences of dehydration, symptoms of shock and uremia, and tetany-like manifestations. The characteristic changes in the blood are a rise in the blood urea, a fall in the plasma chlorids and a rise in the carbon dioxid combining power of the blood plasma. In this type of intoxication the invariable tendency is towards alkalosis, and therefore the use of alkalis in the treatment is contraindicated, although severe toxæmia may exist without tetany. The latter, which is a very disturbing complication, may ensue when the carbon dioxid combining power of the plasma rises above 100 per cent. It is mainly by a study of the chemistry of the blood that the condition can be recognized early, the severity measured, and the extent of treatment gauged and its effect determined. Sodium chlorid, glucose and water, given intravenously in the severe cases, constitute the accepted and only effective method of treatment. Repeated gastric lavage should be the exception, rather than the rule, to obviate the additional loss of fluids and chlorids, of which the tissues are greatly in need. A patient, who came under our observation in 1920 (Table II, Case IX), developed severe toxæmia as evidenced by urinary changes, nitrogen retention, dehydration, shock, low blood pressure, and finally tetany. The patient died after a gastro-enterostomy had been performed, although we realized at the time that the risk was very great. The second patient (Table II, Case XII) was observed in March of this year. He had marked duodenal obstruction, complicated eventually by profound toxæmia and tetany. Treatment enabled the patient to undergo and survive the operation successfully (Table I). The fact that an intolerable situation is relieved and the life of the patient prolonged by gastro-enterostomy, even though it is only a palliative measure, makes such pre-operative preparation a vital procedure.

*Differential Diagnosis*—Because of the rarity of the disease it is reasonable to assume that the condition may sometimes be overlooked. It is almost impossible to distinguish, clinically or roentgenologically, cancer of the supra-ampullary area from pyloric carcinoma or obstructing ulcer. Our series has refuted published traditions that jaundice is the important feature of cancer of the ampullary portion. When jaundice is present diagnosis must be made largely on the evidence afforded by Rontgen-ray methods. However, we have seen duodenal obstruction the result of other malignant processes, such as carcinoma of the head of the pancreas, carcinoma of the gall-bladder, and metastatic retroperitoneal carcinoma. Also, obstruction of the third or infra-ampullary portion has resulted from the caseating mesenteric glands in tuberculous peritonitis. On the other hand, duodenal deformity or obstruction has resulted from heavy bands, from the vessels of Wilkie, from inflammatory masses, the result of a perforating gall-bladder, and from extensive adhesions following gastro-enterostomy, or after taking down a gastro-enterostomy. These malignant and benign conditions are the more important possibilities.

to bear in mind when one is confronted with an actual or apparent lesion of the duodenum other than ulcer, especially when it is associated with obstruction

*Type of Lesion*—With the exception of two large malignant papillomas all the lesions could be classified as stenosing adenocarcinomas. Nagel, in a study of three specimens obtained at necropsy, found an annular, well limited constricting duodenal carcinoma in two, one was above and one below the ampulla of Vater. In both of these cases the head of the pancreas was moderately involved. The third specimen was an indurated ulcerative carcinoma with moderate stenosis, the pancreas was also affected in this case. In one case there was local glandular involvement, but in none was there evidence of other metastasis. Microscopically the three necropsy specimens varied from a fairly well differentiated type of carcinoma with irregular acinous structures, lined by high columnar cells and intertwined with connective tissue strands, to one less differentiated, showing just a few gland-like structures and marked by areas of degeneration and local infiltration with lymphocytic cells. The third represented a type about midway between these two.

#### CONCLUSIONS

1 Of fifteen cases of primary carcinoma of the duodenum, six were in the supra-ampullary portion, six in the ampullary, and three in the infra-ampullary.

2 Twelve of the patients were males, and the average age was fifty-six years. The duration of the disease averaged thirteen and four-tenths months.

3 The onset of symptoms was fairly abrupt in half of the patients. The pain was severe in only two, and mild or negligible in the remainder. In ten the pain or discomfort appeared from one to four hours after meals. Flatulency, pain or distress, the retention type of vomiting, dehydration, and toxæmia were the major symptoms. In most cases the course was rapidly progressive. Jaundice, except as a terminal symptom, was rare, even in the ampullary group.

4 Tumor was found in five (33.33 per cent), and it was present only in supra-ampullary and ampullary portions.

5 In twelve of the fifteen cases in which gastric analysis was made, seven had free hydrochloric acid in subnormal amount, five had achlorhydria. Gross gastric retention was present in all except one. In the infra-ampullary group excess fluid containing bile and pancreatic juice was noted.

6 A dilated stomach with considerable barium residue without a demonstrable gastric lesion was the usual Röntgen-ray finding. In two, gastric and duodenal dilatation and barium retention made an exact anatomic diagnosis possible.

7 The toxæmia of high intestinal obstruction is a serious complication and invariably present in these cases. Diagnosis and treatment are discussed.

8 After proper pre-operative treatment a palliative gastro-enterostomy is a justifiable procedure.

## PRIMARY CARCINOMA OF THE DUODENUM

9 Conditions that may give rise to difficulty in differential diagnosis are malignant and benign pyloric obstruction, carcinoma of the head of the pancreas or gall-bladder with involvement of the duodenum, carcinoma of the ampulla or terminal portion of the common duct, and benign duodenal obstruction, the result of bands when there are supra-duodenal vessel of Wilkie, inflammatory masses, peritoneal tuberculosis, and extensive post-operative adhesions

10 The results of gross and microscopic examination of necropsied specimens are given

### BIBLIOGRAPHY

- <sup>1</sup> McVicar, C S Clinical and Laboratory Clinical Findings in Certain Cases of Obstruction in the Upper Gastro-intestinal Tract, the Role of Blood Chemistry in Diagnosis, Prognosis and Treatment of This Condition Am Jour Med Sc, 1925, vol clxix, pp 224-235
- Nagel, G W Unusual Conditions in the Duodenum and Their Significance Arch Surg (In press)



# EPITHELIOMAS IN SEBACEOUS CYSTS\*

By HAROLD D. CAYLOR, M.D.

OF ROCHESTER, MINN.

SECTION ON SURGICAL PATHOLOGY OF THE MAYO CLINIC

SEBACEOUS glands appear in the skin of the human embryo about the fifth fetal month as single or occasionally double, buds of the hair follicles. These follicles develop as a downgrowth of cells of the stratum germinativum<sup>11</sup>. The distal ends of the anlage become lobulated, fatty degeneration of the central cells of the mass progresses and forms the lumen of the alveoli and ducts of the gland. The fully developed sebaceous gland is a simple or branched alveolar organ scattered through the skin of almost the entire surface of the body.<sup>8</sup> Probably nine-tenths of the sebaceous glands are closely associated with hairs. The duct for each gland usually opens into the sheath of a hair follicle although it may open directly on the surface of the skin. Usually only one gland is connected with a hair but there are cases in which the acini may encircle the hair completely. In certain regions, the forehead and nose for example, sebaceous glands are more concentrated than on the extremities or back. The skin of the palms and soles, and dorsum of the distal phalanges of the fingers and toes is believed by many to be free from sebaceous glands.

The secretion of the sebaceous glands is first noticed about the fourth or fifth year, reaches its maximum in adult life, and tends to disappear in old age. The lining of the duct and alveolus is flattened epithelium. The cells of the margin of the saccule multiply rapidly, and are pushed by growth of those behind into the lumen of the acinus away from nutrition. Here they undergo fatty degeneration until finally they are reduced to the granular fatty, almost cell-free material which is sebum.<sup>9</sup> Modified sebaceous glands are found around the eyelids (meibomian glands), mammary papillæ and areolæ of the female, glans penis and prepuce, labia minora, glans and prepuce of the clitoris.

Atheromas are now regarded as retention cysts caused by the occlusion of the duct of one or more sebaceous glands with the accumulation of the secretion. Usually no duct can be demonstrated. The flat epithelial lining of the wall can be seen and an increasing degree of degeneration of the cells adjacent to the lumen toward the centre, until the final state is noted in the fatty material and cell debris filling the cyst. Lime salts may be deposited in the sebum and, if the cyst is infected, an abscess may develop with inflammation of the adjacent tissue.

Stelwagon asserts that the favorite sites for sebaceous cysts are the scalp, face, back and scrotum. Two hundred thirty-six cases in which sebaceous cysts had been excised at the Mayo Clinic were studied. Two hundred twenty-four were simple atheromas, the remaining twelve were sebaceous cysts.

---

\* Submitted for publication, June 2, 1925

# EPITHELIOMAS IN SEBACEOUS CYSTS

associated with epitheliomas. The group of simple sebaceous cysts was analyzed first. Only cases of proved sebaceous cysts were chosen for the series. Very inflammatory lesions which may have been atheromas were discarded because of the possibility of error. One hundred twenty-one (54 per cent) of the cases occurred in males, and 103 (46 per cent) in females (Table I).

Besides the occupations tabulated there were twenty-eight others, each represented by one patient.

This scalp was the common site of the cysts. Sixty-five patients (29.01

TABLE I  
*Occupation*

	Cases	Per cent
Attorney	5	2.23
Carpenter	3	1.33
Child	5	2.23
Clerk	4	1.78
Contractor	2	0.89
Farmer	48	21.43
Grain buyer	2	0.89
Housewife	84	37.50
Laborer	5	2.23
Mechanic	4	1.78
Merchant	6	2.68
Physician	6	2.68
Plumber	2	0.89
Railroad man	2	0.89
Realtor	3	1.33
Salesman	4	1.78
Stenographer	2	0.89
Teacher	3	1.33

per cent) had wens in this situation. The face and neck followed in order of frequency (Figs 1 and 2). Percentages of the number of patients in the group and of the number of lesions are given in Table II. The fact that some of the patients had multiple lesions in different regions of the body accounts for the difference in the two percentages. A fairly accurate and simple rule is that atheromas decrease in frequency from above downwards. The legs are rarely affected, and the feet practically never.

Approximately 14 per cent of the patients with simple sebaceous cysts gave a family or personal history of malignant disease. Four patients (1.78 per cent) had recurring lesions. Three patients (1.33 per cent) had lesions in surgical scars, two lesions followed breast amputations, and one followed thyroidectomy. Twenty-nine patients (12.94 per cent) had multiple lesions, twenty-two (9.82 per cent) were in the same region of the body. For example, one patient had eight separate cysts of the scalp. Atheromas of the buttocks were invariably diagnosed lipomas by clinicians. The youngest patient of the series was aged six years. He had had two lesions of the forehead since birth. Many patients had had tumors since early childhood, and one man had had a tumor for forty-six years. The tumors varied in size from a few

TABLE II  
*Site of Lesion*

	Number	Right	Left	Median line	Lesions per cent	Patients affected per cent
Abdomen	5	2		3	2 16	2 23
Arm	2	1	1		0 87	0 89
Axilla	7	3	4		3 03	3 12
Back	10		1	9	4 32	4 46
Breast	13	1	12		5 62	5 80
Buttock	8	3	5		3 46	3 57
Cheek	22	12	10		9 51	9 82
Chest	10	4	5	1	4 32	4 46
Ear	1	1			0 43	0 44
Face, including forehead, cheeks, jaw, lips and parotic region	37	21	15	1	16 01	16 51
Fingers	3	1	2		1 29	1 33
Forehead	7	1	5	1	3 03	3 12
Hand (palm)	3	3			2 59	2 67
Hand (dorsum)	3	2	1			
Jaw	3	3			1 29	1 33
Leg	1		1		0 43	0 44
Lip (lower)	1	1			0 43	0 44
Lumbar region	2		2		0 87	0 89
Mastoid region	3		3		1 29	0 89
Neck, including back and front	34	12	9	13	14 71	14 73
Parotid region	4	4			1 73	1 78
Scalp	65				28 13	27 67
Scrotum	2				0 87	0 89
Shoulder	11	5	6		4 76	4 02
Thorax, including front and back of chest and breasts	33	5	17	11	14 28	14 72
Temporal	5	5			2 16	2 23
Thigh	6	6			2 59	2 67

## EPITHELIOMAS IN SEBACEOUS CYSTS

millimeters to 6 cm in diameter. The atheromas developing in the palm deserve mention, for it is generally supposed that there are no sebaceous glands in this situation. The feet and legs were, with one exception, free from atheromas.

Epitheliomas arising in sebaceous cysts have been described by Ricker and Schwalbe, Seff and Berkowitz, and Busfield. Ricker and Schwalbe reviewed the literature up to 1914, and found that forty-three cases of malignant change in atheromas had been reported, these they embodied in their study. In this group there were twenty-two males, sixteen females and in five cases the sex was not mentioned. Seven-

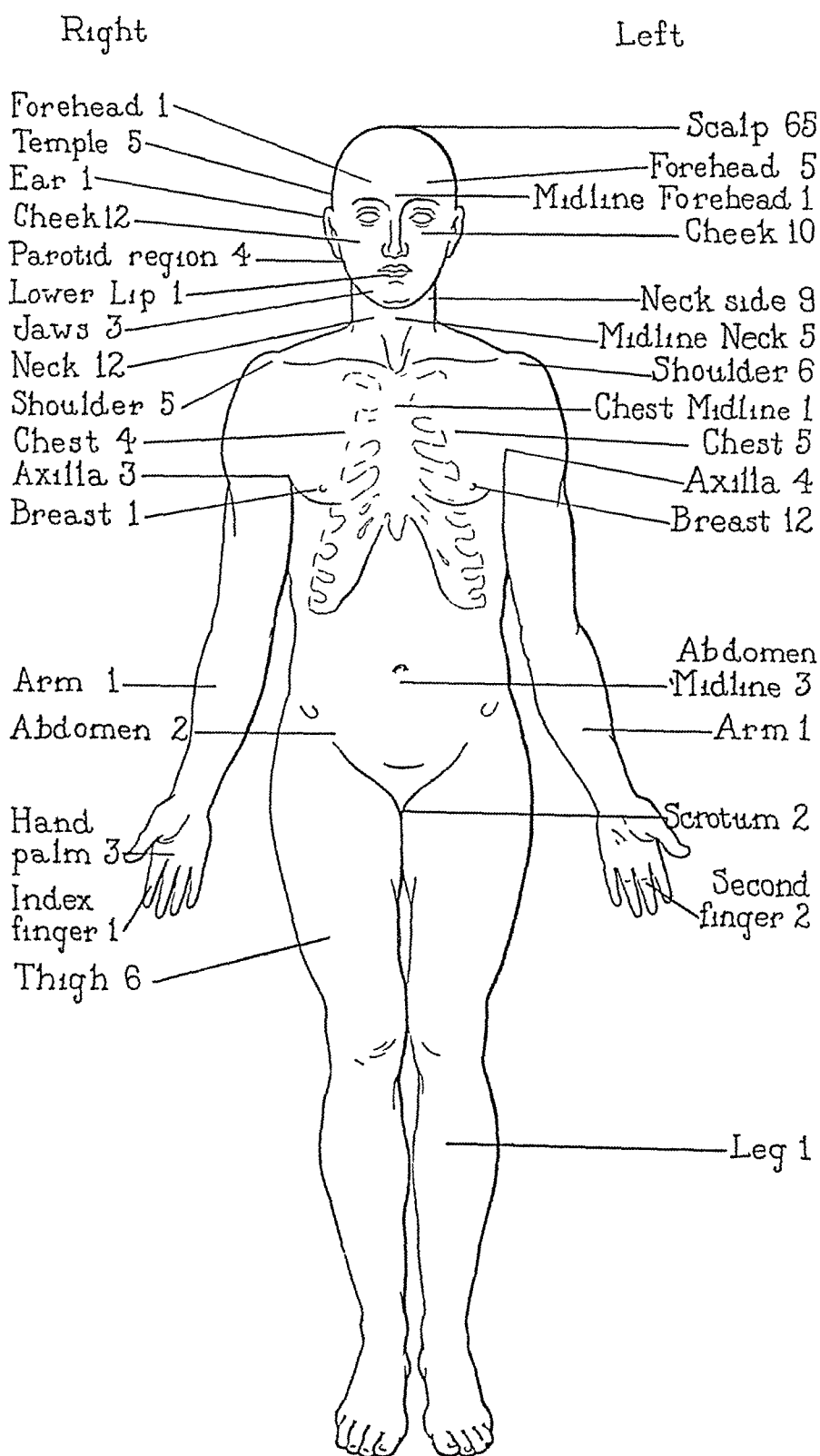


FIG. 1.—The anterior aspect of the body illustrating the number and approximate location of the sebaceous cysts.

teen patients had ulcerated lesions. The lesions predominated in the face, eight were of the meibomian glands of the eyelids, three of the forehead, six of the cheeks, seven of the nose, one of the inner angle of the eye, and seven of the scalp. One patient was aged less than twenty, ten were sixty or

more The tumors usually grew slowly and their size varied from 3 to 10 cm in diameter

Seff and Berkowitz, in 1916 reported three cases of epitheliomas develop-

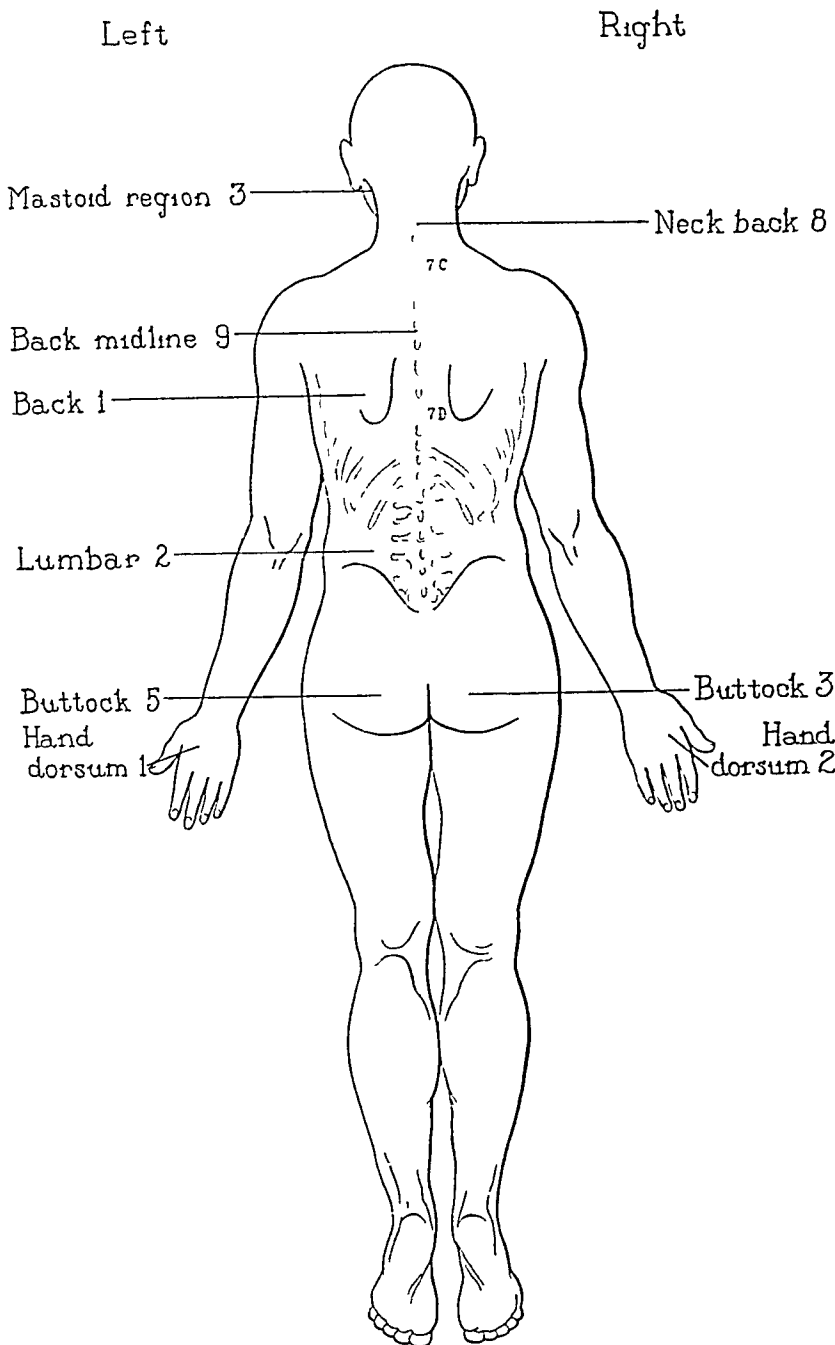


FIG 2 —The approximate location and number of sebaceous cysts of the posterior aspect of the body

ing from sebaceous cysts Their patients were aged twenty-seven, forty-seven, and fifty-one, respectively The cysts varied in size from 1.5 to 2.5 cm in diameter All of the lesions occurred on the head One, the only fatal case, developed in a recurring cyst of the scalp, one was of the forehead and one of the temple Local injury seemed to be a factor in the production of the malignant change Heredity was not a factor in their series Two of the tumors were squamous-cell epitheliomas,

and one a basal-cell epithelioma One lesion was an infected ulcerated cyst

Busfield reported a case of a rodent ulcer developing from a sebaceous cyst of the temple Narat has recently described a case of an epithelioma developing on the surface of an ulcerated sebaceous cyst of the scalp

Twelve cases of epithelioma developing in sebaceous cysts were studied

## EPITHELIOMAS IN SEBACEOUS CYSTS

in the present series † Eight of the tumors were observed simultaneously with 224 simple sebaceous cysts, so that the approximate incidence of malignancy in this group was 3.44 per cent ‡ In a few cases it was necessary to depend on the history given by the patient or attending physician for the diagnosis of atheroma because the malignant condition so overshadowed the microscopic picture that only the neoplasm could be accurately observed and described The tumors in this group, arranged according to MacCarty's classification, are textoblastomas and pseudotextomas<sup>13, 14</sup> Textoblastomas are those malignant neoplasms, "which are composed of cells so undifferentiated that it is impossible positively to recognize the textocytes (adult tissue cells) into which they would develop if differentiation occurred," these tumors are called sarcomas, carcinosarcomas, and so forth Only one case (Case XII) was in this group The remainder of the new growths in this series are grouped with the pseudotextomas, which include those malignant tumors composed of partly differentiated cells, and resembling somewhat normal adult tissue cells of the organism In this group are adenocarcinomas, sarcomas, and most epitheliomas



FIG 3—Basal-cell epithelioma (Case I)  
( $\times 75$ )



FIG 4—Squamous-cell epithelioma grade I showing marked differentiation (keratinization) in more than 75 per cent of the section (Case IV) ( $\times 35$ )

CASE II—A draftsman aged forty-five, complained of a tumor of the left cheek present for twelve years The lesion had ulcerated at intervals Three years after the

### REPORT OF CASES

CASE I—A farmer, aged forty-two, complained of a "sore" and later a "lump" of the nose present for five years With local treatment this tumor ulcerated and discharged thick material The father of the patient had cancer of the face and an aunt had cancer of the arms Examination of the tissue removed at operation revealed basal-cell epithelioma apparently arising in a sebaceous cyst (Fig 3) The ultimate result of this case is unknown

† Since this report one patient with an epithelioma in an atheroma of the scalp and one of the side of the neck have been examined

‡ This percentage is probably higher than would be found in some series because not all sebaceous cysts removed were sent to the laboratory for examination and because highly inflammable lesions in the skin which may have been sebaceous cysts were disregarded in selecting cases

growth was noticed, it was removed and diagnosed a sebaceous cyst, it recurred within three years. Nine years after the recurrence, a second cyst was excised, and was diagnosed a basal-cell epithelioma arising in an atheroma. Three years after the second operation this patient had a recurring lesion of the left cheek.

CASE III—A woman, aged sixty-one, came to the clinic because of a prolapsed uterus. During the examination a cystic tumor about 2 cm in diameter was discovered just be-



FIG 5—The gross appearance of the lesion at the time of examination (Case VI)

neath the skin of the left shoulder blade. The patient did not know how long this nodule had been present. Her father had had a malignant growth removed from his lip. The cyst was excised and found to be an atheroma containing squamous-cell epithelioma, grade 1. The final result in this case is not known.

CASE IV—A woman aged seventy-five, came to the clinic because of a recurring cyst of the scalp. The growth was removed

and found to be a wen. Two years later the tumor recurred and was again excised. The tissue removed at the second operation was found to be squamous-cell epithelioma, grade 1, in a sebaceous cyst (Fig 4). The patient lived three years and eight months after her last operation without recurrence, then died from old age.

CASE V—A man, aged fifty-eight, had had a cyst of the right occipital region for ten years. It had been opened and had drained "pus and cheesy material" at intervals for years. The lesion was removed and proved to be a sebaceous cyst 2.5 cm in diameter containing squamous-cell epithelioma, grade 1, which had differentiated markedly. Nothing definite is known concerning the outcome in this case.



FIG 6—Squamous cell epithelioma grade 1. The edge of an epithelial pearl is shown with complete differentiation of the cells into keratin (Case VI) (x 80)

CASE VI—A man aged forty-nine, came to the clinic because of urinary disturbances and an ulcerating sore of the abdominal wall that would not heal (Fig 5). The lesion had appeared about one year before as a small "boil" or "pimple" near McBurney's point. After violent squeezing on several occasions cheesy material extruded. The lesion never completely healed. It would drain, scab over, and then break down

## EPITHELIOMAS IN SEBACEOUS CYSTS

The tumor gradually increased in size when the patient was examined it was about 3 cm in its greatest dimension. It was excised and found to be squamous-cell epithelioma, grade 1 arising in a sebaceous cyst (Fig 6). There had been no recurrence two months after the operation.

**CASE VII**—A woman, aged fifty-six, had had a "growth" on her right cheek for twelve years. Her father and one cousin had died from cancer. Two years before, a sebaceous cyst had been diagnosed. It was removed promptly recurred and was excised a second time. At the Mayo Clinic a cystic tumor 1.5 cm in diameter was removed and diagnosed atypical squamous-cell epithelioma, grade 2 (Fig 7), apparently arising in a sebaceous cyst. Eight years and one month after operation there had been no recurrence.



FIG 7—Atypical squamous-cell epithelioma grade 2 (Case VII) ( $\times 60$ )

**CASE VIII**—A woman, aged sixty-five, had been troubled with a recurring atheroma of the left cheek for seventeen years. The tumor had been removed twice before the patient came to the Mayo Clinic, the last time seven years previously. At the examination a painless, slightly ulcerated cyst of the right cheek, about 0.5 cm in diameter, was found. Under local anesthesia the diseased tissue was excised. Microscopic examination revealed a prickle-cell type of epithelioma, grade 2 arising in an atheroma (Fig 8). This woman was well without recurrence twelve years and one month after her last operation.

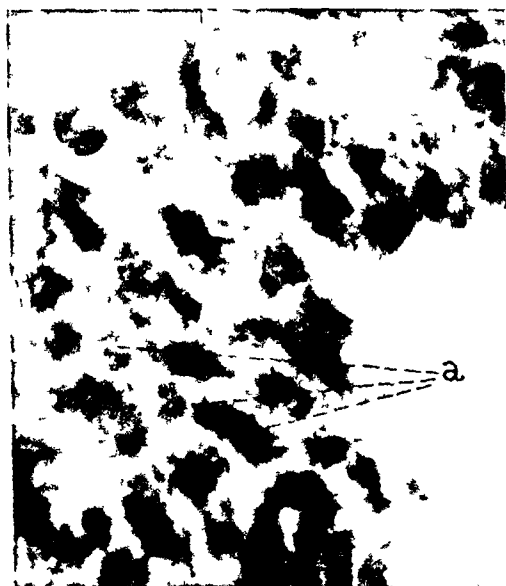


FIG 8—Prickle-cell epithelioma grade 2, high magnification to show the prickles between the cells at a (Case VIII) ( $\times 1200$ )

**CASE IX**—A man, aged forty-four, came desiring advice and treatment concerning a tumor of the front of his left leg just below the knee. This nodule had been present for five years and had slowly increased in size until at the time of the examination it was about 2 cm across. It had never been painful. Under local anesthesia the growth was removed and found to be a sebaceous cyst containing in its lumen a prickle-cell type of epithelioma, grade 2. There was no recurrence three months after removal of the tumor.

**CASE X**—A man, aged eighty-two, had noticed a "pimple" on his left temple for five months before coming to the clinic. This lesion had increased rapidly in size until, at the time of admission, it was about 1.5 cm in its greatest dimension. The tissue removed was a squamous-cell epithelioma 2, arising in a sebaceous cyst (Fig 9). This man died from apoplexy eleven months after operation.

**CASE XI**—A man aged thirty-eight, had had a gradually enlarging "lump" on the back of his head since childhood. An aunt had died from cancer of the breast. Three times in the three months just preceding the patient's visit to the clinic this cyst had been removed but had recurred. At the clinic a wide excision was performed and squamous-cell epithelioma grade 3 was found in an atheromatous cyst. There were many mitotic figures in the malignant cells (Fig 10). This man was alive and well eight years after operation.



CASE XII—A woman aged seventy-one, had had a cystic tumor of the right cheek for twenty years. Three years after it first appeared it was excised, but it soon recurred. Both her grandfathers had died from cancer. The tumor remained about 0.5 cm in diameter until three months before examination at the clinic, when it began to enlarge rapidly. The patient lost 15 pounds in eight weeks. The lesion was an indurated ulcerating area strongly suggestive clinically of malignancy. A piece of tissue, 3 by 3 by 2 cm., was excised, and examination revealed squamous-cell epithelioma, grade 4, apparently arising in a sebaceous cyst. This woman died seven months after operation from carcinomatosis (Fig 11).



FIG 9—Squamous cell epithelioma, grade 2 (Case XI) ( $\times 35$ )

Seven patients (58.33 per cent) in this group of twelve cases gave a family history of malignant disease. The lesions were about equally divided between the sexes, seven being in males and five in females. The age ranged from thirty-eight to eighty-two years. One patient was in the fourth decade and one in the ninth, two each

in the sixth, seventh, and eighth decades, and four in the fifth. Three of the lesions occurred on the scalp, one on the temple, four on the cheeks, one in the nose, one on the shoulder, and one on the abdominal wall, and one on the leg (Fig 12). Four cysts (one-third of the total) had ulcerated. The ulceration was apparently caused by abrasions from combing the hair, rubbing of clothing or by local applications used for treatment.† In most cases there was no history of recent enlargement of the lesion. One growth developed, according to the history, in five months. One fatal case (Case XII) was that of a recurring cyst of twenty years' duration (Table III).

If the contour of the cyst was preserved the epithelioma could be distinguished grossly as a flat or papillary gray to white firm area growing from the wall into the lumen and apparently later invading

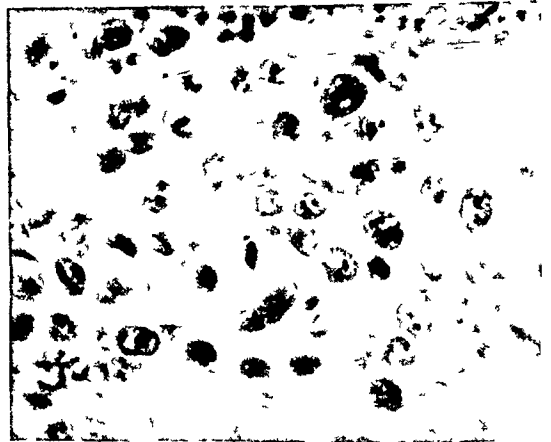


FIG 10—Squamous cell epithelioma, grade 3. Large malignant cells showing little differentiation, many containing mitotic figures (Case XI) ( $\times 350$ )

adjacent structures. Ten of the epitheliomas were the squamous-cell type and two basal-cell type.<sup>1</sup> The squamous-cell tumors, classified according to the method first described by Broders,<sup>2,3</sup> were four epitheliomas grade 1, four

† Kaufmann mentioned an epithelioma developing in an atheroma and observed that ulceration usually came on before the malignant condition was noticed.

# EPITHELIOMAS IN SEBACEOUS CYSTS

epitheliomas grade 2, one epithelioma grade 3, and one epithelioma grade 4. Two prickle-cell tumors were included in this series. They were both graded 2. The prickle cells are usually most readily found close to the blood-vessels where the malignant cells sometimes assume radial arrangement. Under high

TABLE III  
*Clinical Notes*

Case	Age years	Epithelioma	Site	Comment
1	42	Basal-cell	Nose	Father and Aunt died from cancer. Lesion on face ulcerated, nothing known regarding ultimate result.
2	45	Basal-cell	Left cheek	Recurring lesion of cheek. Lesion recurred three years after removal.
3	61	Squamous-cell 1	Left shoulder	Father had cancer of lip. No report from patient regarding present condition.
4	75	Squamous-cell 1	Scalp	Recurring lesion of scalp.
5	58	Squamous-cell 1	Scalp	No report from patient regarding present condition.
6	49	Squamous-cell 1	Abdominal wall	Infected ulcerated lesion of abdominal wall.
7	56	Squamous-cell 2, atypical	Right cheek	Father and one cousin died from cancer. Recurring lesion of cheek. Patient alive and well without recurrence eight years after last operation.
8	65	Squamous-cell 2, prickle-cell type	Left cheek	Recurring cyst of cheek. No recurrence seven years and seven months after excision.
9	44	Squamous-cell 2, prickle-cell type	Left knee	No trouble three months after operation.
10	82	Squamous-cell 2	Left temple	Lesion noticed first, five months before. Died from apoplexy one year after operation.
11	38	Squamous-cell 3	Scalp	Aunt died from cancer. Lesion recurred three times in three months. Alive and well eight years after removal with no recurrence.
12	71	Squamous-cell 4	Right cheek	Both grandfathers died from cancer. Recurring lesion of right cheek. Died from carcinomatosis seven months after operation.

magnification, with the condensor aperture of the microscope very small, the prickles between the cells can be demonstrated. In some areas these tumors resemble the basal-cell type of epitheliomas. Broders' says that he has never seen an epithelioma of the prickle-cell type that spread by metastasis, although from the appearance of the lesions there is nothing to account for this peculiarity. Careful examination of the sections of epitheliomas 1, reveals marked

keratinization of the cells. The differentiation varies in this group from almost complete to approximately 75 per cent. The most highly differentiated squamous epithelium in a tumor is completely keratinized, as is seen in epithelial pearls.<sup>4</sup> But in grading one must not depend only on the formation of epithelial pearls. There are all grades of keratinization of squamous-cell tumors from the slightest to the most extensive deposits in the cytoplasm. An epithelioma graded 3 may contain pearls and the remainder of a section of the tumor be composed of undifferentiated highly malignant cells (Fig 10). In



FIG. 11.—Squamous cell epithelioma, grade 4 composed of large undifferentiated malignant cells containing no appreciable keratin (Case XII) (x 60)

epitheliomas graded 2, the differentiation includes from 75 to 50 per cent of the tissue in the sections (Fig 9). In Case VII the lesion was an atypical squamous-cell epithelioma (Fig 7). The nuclei of the cells were not so chromaphilic as in ordinary flat-cell carcinoma. There was no typical formation of epithelial pearls. The cells of the tumor had lost their usual alveolar arrangement and were scattered with their long axes pointing in many directions rather than in concentric circles, as is seen around

pearls, or in more or less regular strata. The tumor cells were more rounded than was common in squamous-cell carcinoma, and the usual pavement-stone-like cells were for the most part absent. In some areas the tumor suggested a basal-cell type, but more careful study showed it to be composed of atypical squamous cells.

The epithelioma graded 3 showed approximately 30 per cent of differentiated areas. The tumor cells were large and contained hyperchromatic nuclei. There were many mitotic figures. The clinical history of rapid recurrences following partial removal of the tumor in this case was exactly in line with the microscopic picture.

The epithelioma graded 4 was composed of large, apparently rapidly growing cells without cornification. The nuclei of the cells were unusually large. MacCarty<sup>12</sup> has pointed out that with such cells in lymph-nodes it is almost impossible to tell the exact type of neoplasm from which they arose. The extreme malignancy in this case was shown by the death of the patient, within seven months, from generalized metastasis.

#### CONCLUSIONS

Sebaceous cysts can develop in almost any portion of the body covered by epidermis, the palms included. They are retention cysts caused apparently by obstruction of the duct of the gland and accumulation of the sebum. All sebaceous cysts should be removed, for they may become the site of a malig-

## EPITHELIOMAS IN SEBACEOUS CYSTS

nant tumor Approximately 344 per cent of the sebaceous cysts in this series eventually became malignant The lesion should be excised if it is ulcerated, and excision is imperative if the lesion recurs Obviously all sebaceous cysts should be examined carefully for malignant change Heredity was apparently an etiologic factor in the development of epitheliomas in the cysts studied, since 58.33 per cent of the patients with epitheliomas gave a family history of malignancy, while only 13.83 per cent of the patients with simple uncomplicated sebaceous cysts gave a personal or family history of malignancy Local irritation while it may be an item in causing the development of malignant change, was not most important factor

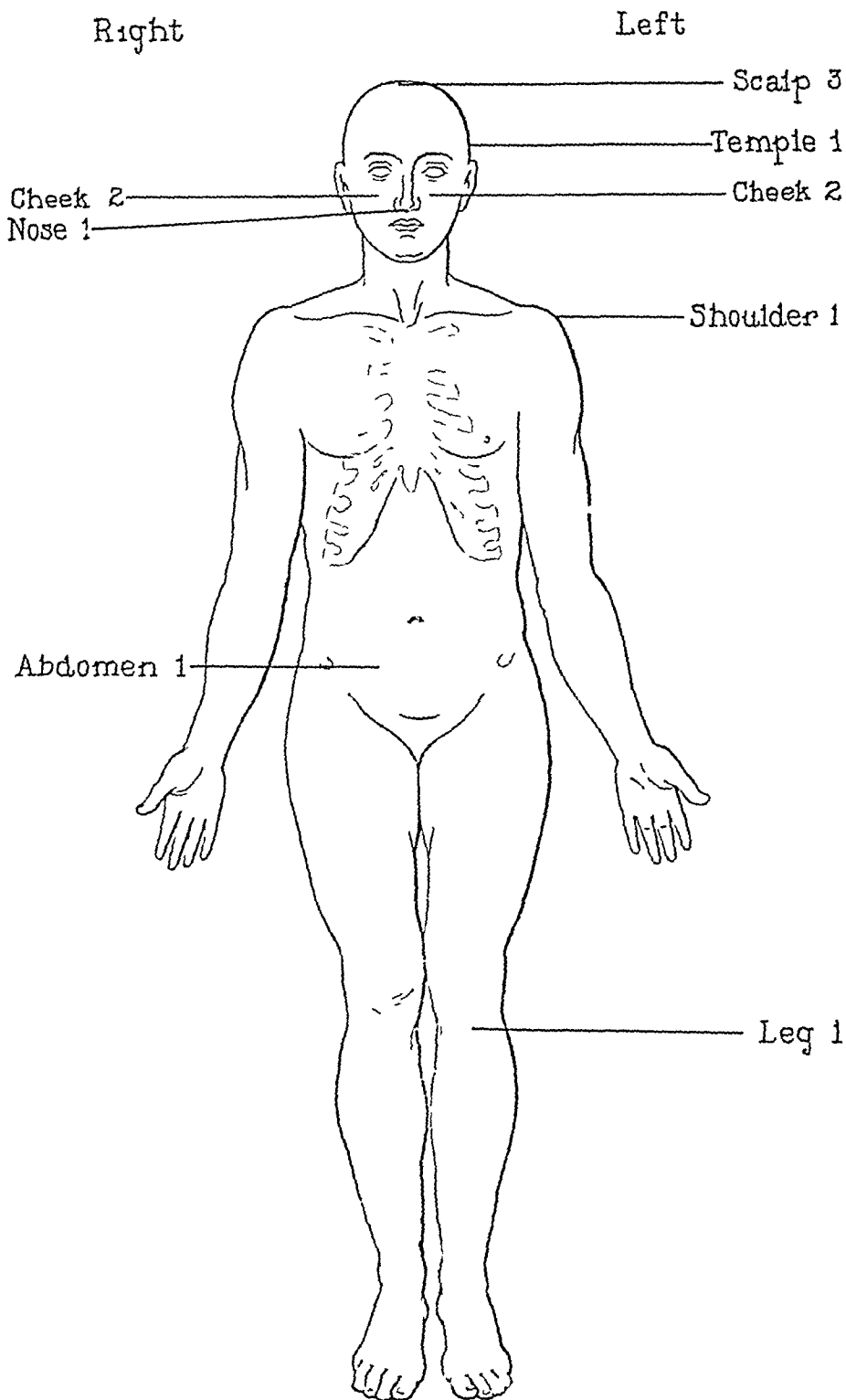


FIG. 12.—The number and approximate location of the epitheliomas in sebaceous cysts

### BIBLIOGRAPHY

- <sup>1</sup> Broders A. C. Basal-cell Epithelium Jour Am Med Assn, 1919, vol LXVII, pp 856-860

- <sup>1</sup> Broders, A. C. Squamous-cell Epithelioma of the Lip Jour Am Med Assn, 1920, vol lxxiv, pp 656-664
- <sup>2</sup> Broders, A. C. Squamous-cell Epithelioma of the Skin A Study of 256 Cases ANNALS OF SURGERY, 1921, vol lxxiii, pp 141-160
- <sup>3</sup> Broders, A. C. Cancer's Self-control Med Jour and Rec, 1925, vol cxvi, pp 133-135
- <sup>4</sup> Broders, A. C. Personal Communication
- <sup>5</sup> Busfield, J. Development of Rodent Ulcer from Sebaceous Cyst Brit Med Jour, 1900, vol ii, pp 1567-1568
- <sup>6</sup> Ewing J. Neoplastic Diseases Philadelphia, Saunders, 2nd ed, 1922, pp 505 and 965
- <sup>7</sup> Jackson, C. M. Morris' Human Anatomy Philadelphia, P. Blakiston's Sons and Company 1923 pp 72-75
- <sup>8</sup> Jordan, H. E. A Text-book of Histology New York, D. Appleton and Company, 3rd ed, 1924, pp 286-290
- <sup>9</sup> Kiuftmann, E. Lehrbuch der speziellen pathologischen Anatomie Berlin, W. de Gruyter and Company, 7 and 8 Aufl, 1922, vol ii, p 1711
- <sup>10</sup> MacCarty, W. C. The Histogenesis of Cancer (Carcinoma) of the Breast, and its Clinical Significance Surg, Gynec and Obst, 1913, vol xiv, pp 441-459
- <sup>11</sup> MacCarty, W. C. Notes on the Regularity and Similarity of Cancer Cells Collected Papers of the Mayo Clinic Philadelphia, Saunders, 1914, vol vi, pp 600-602
- <sup>12</sup> MacCarty, W. C. A Biological Conception of Neoplasia, its Terminology and Clinical Significance Am Jour Med Sc, 1919, vol clvii, pp 657-674
- <sup>13</sup> MacCarty, W. C. A New Clinical Classification of Neoplasms Jour Tenn State Med Assn, 1921, vol xiii pp 385-389
- <sup>14</sup> Nalat, J. K. Some Unusual Cases of Malignant Neoplasms ANNALS OF SURGERY, 1925 vol lxxvi, pp 679-686
- <sup>15</sup> Ricker, S., and Schwalbe J. Die Geschwulste der Hautdrüsen Berlin S. Karger, 1914
- <sup>16</sup> Selt, I. and Berkowitz, S. Carcinomatous Degeneration of Sebaceous Cysts Surg, Gynec and Obst, 1916, vol xlviii, pp 469-473
- <sup>17</sup> Stehwagon, H. W. Diseases of the Skin Philadelphia, Saunders, 8th ed, 1916, p 1080

# CARCINOMA OF RECTUM \*

## REPORT OF OPERATIONS AND PRESENTATION OF CASES

BY JOSEPH A. BLAKE, M.D.

OF NEW YORK, N.Y.

THE cases embodied in this report were operated upon between the years 1906 and 1912 in the Roosevelt and Presbyterian Hospitals. They comprise all of those of which I have been able to find records. I regret that the follow-up in these cases has been so meagre as to make it impossible to state the average duration of life after operation, and thus compare the results of the different operations. The number of operations is also too few to enable one to deduce much from them.

Of sixteen operations ten were combined operations with excision of the lower sigmoid and entire rectum in one stage, with simultaneous formation of an inguinal colostomy. There was no operative mortality in this group. Of these, two are alive, one seventeen the other sixteen years after operation (both presented), one lived twelve and one-half years and is said to have died of recurrence, one died of recurrence in five years and two months, in one other case I was unable to remove the growth and she died in six months. The other five have been lost sight of.

There were six combined operations in which a low anastomosis with preservation of the sphincter was performed. Of those six, there was one post-operative death on the tenth day from pulmonary embolism, the others recovered from the operation. One of these is alive and well fourteen years after operation and has recently taken out a large life insurance. He was under thirty years when operated on. One had a stricture and died of recurrence two years after operation. The other two have been lost from observation.

One patient was operated by the combined method with complete removal of the rectum and anus with the formation of a perineal colostomy. She died on the fourth day from low intestinal obstruction, as proved by autopsy, a few hours after a secondary inguinal colostomy. Of the total 16 cases, there was thus an operative mortality of two, that is, 12½ per cent. Three can be considered as cures, being alive and well from fourteen to seventeen years after operation. There may be others still alive, but we have been unable to reach them.

There were three accidents in the group of combined operations with inguinal colostomy. In one a loop of small intestine herniated between the sutures in the pelvic floor, but the obstruction was recognized and relieved.

---

\* Presented at a joint meeting of the New York Surgical Society and of the Philadelphia Academy of Surgery, held February 11, 1925.

by secondary celiotomy on the third day with uneventful recovery. An ureter was injured in each of two women, in one an anastomosis was immediately done successfully, in the other a persistent urinary fistula resulted.

In regard to the choice of operation for carcinoma, I believe that nearly all surgeons are convinced that the combined abdomino-perineal is the only rational one, and it is needless for me to review the reasons wherefor. They have been very ably stated by Dr. D. F. Jones and proven correct by his results. The only question for discussion being, perhaps, the methods by which the operations should be performed. The cases may be divided into two groups, one in which the growth is low and in which the preservation of the sphincter entails a risk of ineffectual removal. For this group the entire rectum and anal region should be removed and an inguinal colostomy instituted. The other group comprises those cases in which the growth is high and in which there may not be a downward spread to the lymphatics of the perineum, anus and ichio-rectal regions. I say "may not," for there is always a question of doubt. Unquestionably in these higher growths the operation offering the best chance of immunity from recurrence is complete excision and inguinal colostomy, but in the face of strenuous opposition to an inguinal colostomy one is justified perhaps, if all concerned understand the risk, in preserving the sphincter and doing a low anastomosis. The one in my series who has had no recurrence fourteen years after the operation, in whom this low anastomosis was done, had a relatively high growth just reached by the examining finger. I feel that complete extirpation and inguinal colostomy is the best operation for all cases and the only permissible one for low growths and I have refused to operate on such cases unless they permitted me to do it.

In regard to the operative mortality of the combined abdomino-perineal operation, all my operations have been done in one stage, that is, the colostomy has been done and the rectum removed at the one operation. There have been more than ten of these operations, as I reported fourteen in 1911, and there have been a few since then. The last case I operated died, a woman of seventy-five years. All the others recovered from the operation. The operation is a shocking one, but a clean one, and convalescence is rapid. To perform it properly, there should be three assistants, one at least of whom should be an experienced operator, and the team work must be good.

As I have done it, a sufficiently long median incision is made, the operability determined, the site of division of the intestine selected, and then a split muscle (McBurney incision) made through the left lateral abdominal muscles. Through this incision a long clamp is introduced and the gut strongly clamped at the point of division. Another small clamp is placed just below this and the gut divided with the cautery, and the proximal end pulled out through the lateral incision, thus completing the colostomy, no suture being necessary. The pelvis is then dissected as usual, freeing the gut as low as possible. The

## CARCINOMA OF RECTUM

patient is then put in the lithotomy position and the operator completes the perineal dissection while the first assistant closes the floor of the pelvis and the abdominal wound. The perineal wound is closed, and a stab drainage wound made alongside the sacrum for a fan-sized drainage tube.

### BIBLIOGRAPHY

- Blake, J. A. The Operation of Choice in Carcinoma of the Rectum. N. Y. Med. Jour., July 1, 1911.  
Jones, D. F. End Results of Operations for Carcinoma of the Rectum. ANNALS OF SURGERY, vol. lxxvi, Sept., 1922.



TRANSACTIONS  
OF THE  
NEW YORK SURGICAL SOCIETY  
AND OF THE  
PHILADELPHIA ACADEMY OF SURGERY

*Joint Meeting Held February 25, 1925*

DR EUGENE H. POOL in the Chair

SYMPTOMS AND LATE RESULTS IN NEOPLASMS OF THE SPINAL CORD

DR CHARLES A. ELSBERG read a paper with the above title, for which see p 1057, ANNALS OF SURGERY, vol XXXI

In illustration of his paper Doctor Elsberg presented a number of patients as follows

CASE I—A young man upon whom he had twice operated for an extramedullary spinal cord tumor at the sixth cervical segment. A well-encapsulated tumor was removed which was reported by the laboratory as a fibroma. Two years later he returned to the hospital with a recurrence of his symptoms and at the second operation performed in 1921, a second well-encapsulated growth together with a small piece of dura, was removed. Convalescence from the second operation was satisfactory, and the report from the laboratory was that the tumor was a spindle-cell sarcoma.

CASE II—A man from whom he had removed an extramedullary leiomyoma at the second and third cervical segments. When he was admitted to the Neurological Institute, the symptoms and signs pointed to a tumor at the second cervical segment. At the laminectomy an extramedullary tumor was removed from the level of the second cervical segment. It had a process extending through the dura and through an intervertebral foramen. The tumor was a leiomyoma which contained a large number of blood-vessels. Improvement was noted by the patient as soon as he awoke from the anæsthesia and there was a steady and rapid return of power in all four limbs. He has completely recovered.

CASE III—A patient from whom he had removed an extramedullary spinal cord tumor from the level of the seventh segment in 1921. The tumor lay in front of the cord and had caused a slightly marked spastic paraplegia with sensory disturbances that were more like those of a growth within the substance of the cord. The patient suffered also from gastric distress after meals and on account of the gastric symptoms had been operated upon in another institution for suspected gastric ulcer which was not found. This patient demonstrated that abdominal symptoms of spinal root origin may be mistaken for symptoms of intra-abdominal disease.

CASE IV—A woman, twenty-five years of age, from whom in 1923 he had removed an extramedullary tumor from the left and posterior surface of the cord at the eleventh to twelfth thoracic segments. The patient had a positive Wassermann reaction and gave a five months' history of numbness in the toes of the left foot which had gradually spread up to the left leg. Ten

weeks before the operation the right limb became affected and soon walking became impossible

Upon physical examination, it was found that the left lower extremity was weaker than the right. There were marked sensory disturbances which involved dermatomes only up to the fifth lumbar, and muscle and joint senses were markedly impaired in the lower limbs.

The unusual features of the case were the rapid onset of the symptoms in the presence of a positive Wassermann reaction and the very rapid return of function after the removal of the tumor, so that within a few weeks all of her motor and sensory disturbances had disappeared.

CASE V—A woman, with a history of four years' duration, from whom he had removed an extramedullary tumor from in front of the cord at the level of the fourth cervical segment. The physical signs presented by the patient were mostly those of a right hæmiparesis, and it was of interest that tactile sensibility was normal all over the body, while pain and temperature sensibility were only slightly disturbed. The manometric tests failed to show any distinct interference with the circulation of spinal fluid. The patient recovered satisfactorily from the operation and left the hospital twenty days after the surgical interference. She has steadily improved since that time.

DR JAMES H. KENYON presented a woman, thirty years of age, whose symptoms began in 1922 with pain in both shoulders, but mostly in the left. A few months later the legs seemed to be weaker, the pain had extended down the left side, also across the lower abdomen, and there were various sensations of heat or of pins and needles in the soles of the feet, particularly the right.

By October, 1923, about one and a half years after the onset, she could not walk at all, had a tight band-like sensation at the nipple line, breasts were very tender, so that she could scarcely touch them. Breathing became difficult and a deep-seated pain appeared in the centre of the chest. Two months later she could not stand, could scarcely sit up, and was uncomfortable all the time. Urination became frequent and scanty and the bladder never felt empty.

March 14, 1924, she entered the Neurological Institute, unable to stand or walk, could not even sit up, could not pass any urine, had to be catheterized. The band-like sensation around the nipple line was worse, paræsthesia of legs and feet more pronounced, especially on the right side.

With a diagnosis of tumor of the spinal cord, extra-medullary, but inside the dura at the level of first thoracic vertebra, on March 29, 1924, he removed the spines and laminae of the seventh cervical and first thoracic vertebrae. Color and contour of dura normal, rather tight, no pulsation. Some increased resistance felt on palpating dura under the seventh lamina. Dura opened, very little fluid, tumor exposed, an elliptical incision in the adherent dura overlying it was made. By slight traction on this piece of dura and gentle manipulation with a separator the tumor was easily removed without any trauma to the cord. During this manipulation the usual amount of clear fluid escaped, showing that there had been a partial block of the spinal canal. The tumor was molded around the posterior surface of the cord at the level of the lamina of the seventh cervical vertebra. It measured 2.5 by 2 by 0.5 cm., it was not adherent to the cord or nerve roots.

*Pathological Examination*—Endothelioma.

*Post-operative Course*—The patient could move her legs on the third day, was out of bed on the twelfth day and on the thirteenth day walked the length of the hall, something she had not done for five months. She left the hospital on the twenty-eighth day. At the present moment, February 25, 1925, the patient is normal in every way, all tests are normal. She walks perfectly. The bladder function is all right.

DR CHARLES H FRAZIER (Philadelphia) reviewed the last forty cases of presumptive spinal cord tumors, covering his experience in the last few years, in which a laminectomy had been performed. He regarded the most difficult problem in spinal cord tumors to be the diagnosis rather than the localization, differing in this respect from brain tumors in which the reverse is true. One learns more, perhaps, from reviewing one's mistakes than displaying one's successes, so the speaker had selected the eight of these forty cases in which he had failed to find a tumor, cases in which the diagnosis had been inaccurate. These cases proved to be multiple sclerosis, amyotrophic lateral sclerosis, transverse myelitis and various syphilitic lesions.

These diagnoses had been confirmed by the subsequent course of events and by the development of symptoms not apparent before the laminectomy was performed. Of these eight cases in which a mistake in the diagnosis had been made, six had been referred to him by competent neurologists as spinal cord tumors.

In the matter of diagnosis, Doctor Frazier thought it perhaps not so important what these eight cases presented as what they did not present. In these failures there was in none a typical tumor history and especially notable was the absence of pain. In the majority of cases, in 90 per cent of his own series of verified spinal cord tumors, there was a definite, typical spinal cord tumor history, that begins with pain and months' duration, sometimes years, and always and continuously referred to the same region. Pain is the most important and essential feature not only in the diagnosis, but often in the localization of spinal cord tumors. As they begin with pain, there follow paræsthesias and almost always after these the motor disturbances, atrophies, paresis or paralysis. *In only 10 per cent of his series was there a painless history* and in every one of these the tumor proved to be extradural. These percentages may differ from those of Doctor Elsberg's series, if so, this can be explained by the difference in the point of origin of the tumors.

In the majority of mistaken diagnoses difficulty was experienced in the attempted segmental localization. In the verified tumor there is invariably one or more of the following suggestive features, a precise sensory level, definite pain distribution, sympathetic phenomena, loss of a single reflex, muscle atrophy, involvement of the diaphragm. Except in lesions of the cauda equina the pelvic viscera were not involved until comparatively late. One of the outstanding points in differential diagnosis is this, the findings must be definite, not vague, they should be clear cut, not difficult of interpretation. He usually found when he had made a mistake that the history was atypical, the physical findings were not sharp and clearly defined. In one of his series which proved later to be a case of multiple sclerosis, the objective symptoms were vague and the history by no means typical. In one case of amyotrophic lateral sclerosis, while the early history was suggestive, there was no well-defined sensory level. In one case of transverse myelitis the course was rapid, pain was not a prominent factor, incontinence developed

early. Hind sight is better than foresight, but the true nature of the lesion did not reveal itself in these mistaken diagnoses until some time after the exploration.

Too much emphasis, the speaker thought, had been laid upon the presence of a spinal block. It is not a matter of vital importance. It is gratifying of course to know if the patient has a spinal block, but one's judgment should not be overinfluenced by it. If in cases without evidence of spinal block an exploratory laminectomy is not performed, many tumors will be overlooked, and *per contra* there may be cases of spinal block in which the block is not due to tumor, but to some other lesion, a pachmeningitis or a meningomyelitis. For these reasons one should place a reservation on the importance of spinal block.

Among the verified tumors there was only one in which the tumor was not uncovered at the first operation, in this case the segmental localization was higher than the lesion. As a rule, if an error has been made the lesion is higher rather than lower than the anticipated level, and it becomes necessary to remove one or two laminae above the contemplated exposure, but in this case the reverse was the case. Eleven per cent were extra-dural, in one the tumor was both intra-spinal and intra-cranial, in 10 per cent the tumor was intramedullary and in 4 per cent caudal.

As to the end results of operation. In two of the speaker's series in which the tumor was found and removed, there was no recovery of function, the duration of the lesion being two and six years. In all but these two there was recovery of function both motor and sensory and the patients became ambulant. In some cases recovery of function is surprisingly slow, when the disturbance of function must be the result of pressure and not of degeneration. In only one case was there a recurrence. An average of twenty-three months had elapsed before the tumor was removed.

The chief and foremost concern, therefore, in tumors of the spinal cord is diagnosis and segmental localization. The tumors are of such a character that they present few if any technical difficulties, except when they have gotten beyond the confines of the spinal canal. Perhaps the most important point to be emphasized is the excision of that portion of the spinal membranes from which the tumor takes its origin.

DR J. STEWART RODMAN (Philadelphia) said as to the matter of pain this is one symptom that could be relied on more than others in the diagnosis of spinal cord lesions. However it may be absent at times, and it may not always be characteristic, and so, therefore, it may lead one astray except in the presence of other pathognomonic symptoms. The presence or absence of pain has much to do with pressure on the posterior roots. He had been disappointed after removing extra-medullary tumors and then having the symptoms of spinal cord pressure continue. How long it takes for irreparable spinal cord damage to come about he did not know. He recently operated on a case of fibro-lipoma beautifully located by neurological findings of lipoidal but post-operatively the symptoms continued and the patient is no

better now than before the operation. He emphasized, again, that one should look to the early neurological diagnosis as still being the most reliable diagnostic help in tumors of the spinal cord.

*DOCTOR ELSBERG, in closing the discussion, said that of course errors in diagnosis were being made, tumors not being found as expected, but this much could be said, namely, that the knowledge gained from lumbar puncture and the manometric tests had been of no little help in these doubtful cases which he classed as B or C. Class A are the typical cases, Class B not so much so, and Class C includes those which are probably not tumors. In Class B the manometric tests have helped in the correct diagnosis of not a few cases. Where spinal block exists, it may be caused by a number of different diseases, and in the group of doubtful cases undoubtedly the manometric test will help one in a certain proportion of cases to gain an increased amount of information.*

#### CARCINOMA OF RECTUM. REPORT OF OPERATIONS AND PRESENTATION OF CASES

DR JOSEPH A. BLAKE (New York) read a paper with the above title, for which see p. 177, *ANNALS OF SURGERY*, vol. LVIII.

DR CHARLES H. PECK (New York) presented two cases, one well after seventeen years and one at about three years. One other case, entirely well after six years, failed to come, but reported by letter that she was entirely well. The first two were both perineal resections without laparotomy. The last one was a combined one-stage operation with the proximal end brought down to the anal sphincter. He also has a case well and free from recurrence with a permanent inguinal colostomy after five years. His personal cases since 1915, a working period of about eight years, total 44, of these 22 cases were radical resections with 7 deaths.

The method of operation included combined operations in one and two stages, and a few perineal operations without laparotomy. He is inclined to favor the two-stage combined operation as the most ideal, although his best late results chance to be cases in which the perineal operation was done.

DR FRANK S. MATHEWS (New York) presented a woman who had been operated on at the age of forty-two for carcinoma of the rectum, eleven and a half years ago, the growth being an annular one felt through the vaginal fornix in the cul-de-sac, but not palpable through the rectum. By an abdominal incision, the growth was removed, the division of the gut beyond the growth being at the floor of the pelvis, so that the distal segment had only a partial peritoneal covering. The proximal segment was inverted about a tube and sutured to it. It was then drawn through the distal segment and, by traction on the tube from below, the upper segment was partly invaginated into the lower. The tube came out in eight days, bowels moved on the ninth, and patient left the hospital in two and a half weeks. The growth infiltrated all the coats of the rectum, but the nodes examined were not involved.

He always precedes a perineal operation by an abdominal exploration to determine the condition of the liver and the regional lymph-nodes, and making a left colostomy which permits one to maintain a cleaner perineal wound and which could be closed later if conditions permitted.

DR ALLEN O. WHIPPLE (New York) presented a woman, who was forty-one years of age when she came to the Presbyterian Hospital on March

## CARCINOMA OF RECTUM

16, 1916, complaining of pain in back on evacuation of bowels, loss of weight and strength, diarrhoea of five months' duration. The onset had been gradual with pain in back and pelvis while at stool and feeling of not having completed evacuation of bowels. Began having frequent stools containing blood for two and a half months, four to eight stools a day, considerable blood and mucus. Examination revealed a nodular mass in the rectum ten centimetres above the anus. It was freely movable. The rectum was excised March 27, 1916, by Dr. George E. Brewer.

DR. GEORGE WOOLSEY (New York) reported the history of a man, who, September 4, 1901, being then forty-three years of age, was admitted to the Presbyterian Hospital on account of bloody discharges from the rectum with pain on defecation. Examination showed just inside the internal anal sphincter an uneven villous-like growth encircling the rectum, more prominent on the right side. It seems continuous with the prostate, which is enlarged especially the right lobe, which feels nodular and firm. The growth feels hard, the base is infiltrated and irregular, and it is painless on pressure.

September 6, 1901, Doctor Woolsey operated as follows. Left inguinal colostomy.

Five days later, September 11, 1901, a Kraske resection of the rectum was done under gas and ether. The growth was found to extend to about five inches above the anus. Above this point the rectum, after dissecting off the peritoneum, was cut away from the gut above and removed, with the pelvic fat and glands behind it. The upper free end of the gut was then brought down and its mucosa sutured to the free margin of the anal portion, while its outer layers were sutured to the external sphincter to relieve any tension on the mucosal suture. There was practically no tension on the rectum. The wound was lightly packed with gauze, after suturing the upper half of the skin incision. A gauze pad was introduced through the colostomy opening into the distal segment to prevent faecal matter entering the lower part of the bowel. All stools were passed through the colostomy until the sixth day, when the pad was removed. Two weeks after operation the lower end of the gut had separated from the anus by about two inches and faecal matter passed mostly through the granulating wound, partly through the colostomy. The complete granulation and closure of the posterior wound was a slow process. Four months after operation there was still a small sinus through which part of the faecal matter was passed. The colostomy was not completely closed.

The *pathological report* was malignant adenoma, invading all tissues. A lymph-node examined showed no invasion by the growth.

About a month ago he was asked by Doctor Whipple to see this man upon whom he had operated twenty-three years ago, who was again under treatment in the hospital on account of a large mass on the left side of the neck, and a smaller one on the right side. Microscopic examination of a specimen from the neck showed Hodgkin's disease. On examining the rectum there was a slight constriction at the level of the internal sphincter but no sign of recurrence on digital or proctoscopic examination. The colostomy had never been undone and it formed a hernial protrusion, on which, from time to time, a small spot corresponding to the stoma would open up and form a very small discharging sinus. He had good control of the bowels except when they were very loose. He was in the hospital being treated for Hodgkin's disease, when February 17, he died suddenly from an intestinal hemorrhage which was shown by autopsy to come from a duodenal ulcer that had given no symptoms and was not suspected. As a result of the autopsy and the microscopic examination,

Doctor Von Glahn, Pathologist of the Presbyterian Hospital, reports that there is no trace of any recurrence of the new growth, but extensive lesions of Hodgkin's disease

DR JOHN H GIBBON (Philadelphia) said that notwithstanding the excellent late results following operation for cancer of the rectum in some cases which had been exhibited, this condition remains one of the unsatisfactory fields of surgery. If one is able to remove a rectum fairly early for carcinoma, the ultimate results are remarkably good. The one thing of primary importance in deciding an operability in these cases is the question of metastasis. The size and extent of the growth is not all one wants to know, especially in young people. He had been so astonished to find early metastasis to the liver in people of thirty to forty years of age without any evidence of it that he determined long ago never to do an operation on the rectum without opening the abdomen. This eliminates the posterior operations unless preceded by this earlier exploration. An anterior colostomy is more comfortable than a posterior and, as far as function is concerned, is much better. Many of the far-advanced cases live as long without operation as with it. No case with metastasis should be subjected to a radical operation. His experience in trying to preserve the sphincter had been very unsatisfactory, these resulted in either stricture or incontinence.

DR DAMON B PLEIFFER (Philadelphia) said that one of the chief reasons why this subject is in the chaotic state it is, is because of the extraordinary variation in pathology and clinical behavior of different growths in different individuals. Carcinoma varies quite as much as any disease. He recalled a woman operated on sixteen years ago for a small carcinoma of the rectum above the internal sphincter, who is alive to-day and free from recurrence. Four years ago he had in the same hospital and at the same time two patients, a man and a woman, who each had a growth, which had been apparent for one year, completely encircling the bowel. The growths were small and freely movable and the outcome seemed favorable. The same operation was done on both. The man developed large metastases and died in six months. The woman showed no metastasis and is alive to-day. That factor of variability of pathology should always be borne in mind in considering which operation will fit the case. Many recoveries are on record from different sorts of operations and the factor of malignancy has been disregarded. There is a definite etiological picture connected with malignancy. It exists primarily whether it can be recognized microscopically or not, and it has to be taken into consideration when deciding which operation will give the best results. In spite of the recorded successes of the different operations, it has become clear that if one is to have notable successes that can be expressed in terms of percentages rather than in terms of results, one must achieve it the same as with carcinoma in other fields, one must consider the zones of spread, the natural path of metastasis. He was very pleased to hear that anyone could report ten successful cases of combined abdominal and perineal excision. Fifteen years ago this number of cases without mortality would have been astonish-

ing Miles the chief exponent of this combined operation, has confessed to 20 per cent mortality and in general hands the mortality would be higher than that. The work on cancer of Francis Miles, of England, the Mayos, and of Doctor Jones, of Boston, is spreading the gospel of complete operation. A two-stage operation can sometimes be done where one cannot be attempted in the average hands. One must remember that many of these patients are in a state of impaired vitality. One should remember that many such patients cannot stand successfully a complete operation in one stage. Finally, one must remember that the technic of the combined operation must be thoroughly learned before it is applied, to avoid loss of time, loss of blood, shock and infection and control of the spread of infection. The speaker's own failures had been due to his not applying these underlying principles. On the other hand, he had been fortunate enough not to lose cases where he had not transgressed any of these principles. He believed the aim of those devoting their time to surgery of the rectum should be to secure mortality rates which would compare favorably with surgery in other conditions, such as gastric carcinoma.

DR DANIEL F JONES (of Boston) said that he had been an advocate of the combined abdomino-perineal operation for carcinoma of the rectum for many years. The combined abdomino-perineal operation in one stage is, he believes, the ideal operation, but it is true that the operation is not suitable for every patient, and if one wishes to operate upon the highest possible percentage of the patients seen, one must choose a suitable operation for each patient.

As many patients are too old or too feeble to stand the one-stage combined abdomino-perineal, he has developed a two-stage combined abdomino-perineal operation which may be used in a certain number of those who cannot stand the operation in one stage. There are some too old or too feeble to stand the operation in two stages, then a colostomy is done and some weeks later amputation by the perineal route as recently advocated by Lockart-Mummery.

There are a few cases in which the growth is sufficiently high to use the operation suggested by W J Mayo, in which the dissection is carried down below the growth by the abdominal route, the bowel sectioned below the growth, and the proximal end brought out, after removal of the growth, for a permanent colostomy, and the distal end closed.

Radium must be considered in the treatment of carcinoma of the rectum, but it should be confined to those too old, too feeble, or too fat for operation, and to the inoperable cases. In these the sphincter is removed, except in a very few carefully selected cases. If it is left it may be so weakened as to be valueless and a stricture may result or a sinus may remain. The patient is more uncomfortable with a sphincter that does not control or a fistula, than he would be with a good colostomy. but the chief reasons for doing a permanent colostomy is that in leaving the sphincter one is always tempted to section the bowel too close to the growth either above or below. Another reason is



that the recurrence is frequently in the pelvis and this may involve the bowel and cause obstruction a second time

Some one has said that these patients frequently live for years without operation and implied that it might not be necessary to operate. Because they do live so long and are so uncomfortable while they do live is one of the chief reasons for operating

Removal of the growth should be undertaken even though it is evidently nothing more than a palliative operation. Colostomy alone does not give the comfort that excision of the growth does. The combined abdomino-perineal operation has been done in the presence of small nodules in the liver. These patients usually live a year or more and six months of comfort repays one for going through the operation

The speaker has for several years been looking for statistics on various operations for cancer of the rectum and felt fortunate in getting the statistics for the perineal operation at St Mark's Hospital, London, as presented by Gabriel in the January, 1925, issue of the British Journal of Surgery, to compare with the statistics in the combined abdomino-perineal operation. The figures without brackets in the tables are the figures from St Mark's Hospital, London, as given by Gabriel for the perineal operation, while those in brackets are for the combined abdomino-perineal operation by the speaker

TABLE I

*Cases Grouped According to the Length of Time which has Elapsed Since Operation*

	Less than 3 years after operation	Between 3 & 5 years after operation	More than 5 years after operation	Totals
Number of cases	58 (19)	22 (16)	63 (22)	143 (57)
Immediate mortality	7 (1)	6 (0)	9 (3)	22 (4)
Subsequent mortality	8 (3)	9 (6)	27 (7)	44 (16)
Untraced	1 (0)	1 (0)	11 (1)	13 (1)
Alive with recurrence	3 (1)	1 (1)	1 (0)	5 (2)
Alive and well	39 (14)	5 (9)	15 (11)	59 (34)

TABLE II

*A Comparison of Immediate Mortalities Perineal and Abdomino-perineal Operations*

	Number of cases	Operability rate	Mortality
Perineal	143	44%	15.4%
Abdomino-perineal	(57)	(60%)	(7%)

TABLE III

*Comparison of Perineal and Abdomino-perineal Operations as to Percentage of Cures*

Descriptions	3 year cases	5 year cases
(a) Figures based on total numbers submitted to operation	23.5% (44%)	24% (41%)
(b) Figures based on survivals from operation	28.5% (50%)	28% (52%)

DR WILLIAM C LUSK (of New York) said he would like to say a friendly word in favor of saving the sphincters in suitable cases, and doing the ideal operation of resection of the rectum in which the sigmoid flexure is liberated by the abdominal route, and brought down and united by circular interrupted sutures to the distal rectal segment above the internal sphincter by the posterior route. The cases for which this operation might be suitable seemed to him to be those of early carcinomata which were situated sufficiently high above the internal sphincter. He operated on such a case in June, 1910, and the wound healed without any stricture of the rectum and with perfect function of the sphincters. This man was alive and well to-day (See "Resection of the male rectum for cancer by the combined method in two stages, first stage under Spinal Anæsthesia," *ANNALS OF SURGERY*, December, 1910). He had illustrated this operation ("A Technic of Resection of the Male Rectum", *Surgery, Gynecology and Obstetrics*, November, 1909).

DOCTOR LUSK said that Doctor Whipple's experience with cæcostomy and appendicostomy, as preliminary operations before rectal excision, had corresponded with his own experience with what he called the left subcostal colonic vent, which was a tube-sinus established in the descending colon just below the tip of the left eleventh rib, in advance of the operation for removal of the rectum. This site for the fistula was well apart from the lower abdominal wounds. He showed pictures illustrating the construction of the vent (Technic Through an incision half an inch below and parallel to the left eleventh rib, the peritoneum is opened opposite the tip of the eleventh rib, and the opening enlarged backward to the site of reflection of the peritoneum onto the descending colon. The lower edge of the peritoneum is then drawn outward over the entire thickness of the cut muscles of the lower lip of the wound in the abdominal wall and fixed in this position with sutures. A cone-shaped fold of the descending colon, caught up by a thread, is then pulled outward over the everted lower peritoneal flap, to which latter its base and margins are sutured so as to maintain its protrusion. The upper edge of the peritoneal opening is first sewed to the deep margin of the transversalis muscle, and then below to the base of the cone-shaped protrusion of the bowel along the line of its emergence from the peritoneal cavity, and beyond the bowel protrusion, to the lower flap of the peritoneum. Two loops of Pagenstecher thread are inserted into the exposed surface of gut to locate the site for subsequent puncture. The angles of the wound may be drawn together. Gauze is inserted to prevent adhesions from taking place over the exposed bowel surface.)

The advantages of this fistulous opening are the following. Before the operation for removal of the rectum, (1) the portion of the bowel above the tumor could be washed out, and also (2) gas from the intestines would escape leaving the belly flat. In one case of rectal extirpation which he had operated upon with this preliminary device the intestines were so flat, that when he sutured together the abdominal wound, an air space was left

within the peritoneal cavity. At the operation in the presence of this vent, (3) an artificial anus could be sewed up tight without opening for several days, while the wounds were healing, (4) when the artificial anus was then opened, the size of the aperture could be regulated. Following the operation, a most important feature was that (5) as soon as the patient was put to bed, water could be introduced into the bowel and (6) post-operative intestinal distention was prevented. During convalescence (7) the lower bowel was handily cleansed by enemas given through this vent. Thus the vent gave much comfort to the patient, lessened the dangers of the operation, and as well lessened the anxiety of the operating surgeon.

He said one problem he wished to mention was the existence with comparative frequency of a narrow pelvic cavity, which latter could be so narrow that it was impossible to get the knuckles within it through the posterior route, where the sacrum was cut across through the fifth sacral vertebra. Johae (*Beitrag f Klin Chn*, vol x, 1893, p 755) had determined a relationship between the distance between the posterior superior spines of the ilium and the size of the pelvic cavity. Doctor Lusk said that he had confirmed the truth of this relationship by anatomical study on cadavers, he having found that if the distance between the inner surfaces of the posterior superior iliac spines was as great as  $2\frac{3}{4}$  inches, then in the cadavers in the absence of any tumor of the rectum, the superior hemorrhoidal vessels could be reached and tied through the posterior route, but when this distance was as small as  $2\frac{1}{2}$  inches, that then one attempting to tie the superior hemorrhoidal vessels through the posterior route was sure to have trouble from lack of room. He regarded that the narrow pelvic cavity was a big problem in rectal extirpation. To in part meet the difficulties in the presence of this condition he thought that at least the superior hemorrhoidal vessels should be tied, and the lateral pelvi-rectal fascial attachments isolated and cut downward as far as possible, and the peritoneum all around the rectal segment severed if possible, by the abdominal route, to facilitate removal from below. In an extreme case, the possibility of a resort to symphysiotomy had occurred to him. He had once bisected the sacrum up to the level of the third sacral foramina, fracturing the sacrum across at the latter level and reflecting the two halves outward, without gaining workable space.

#### LATE RESULTS OF RESECTION OF THE ŒSOPHAGUS FOR CARCINOMA

DR FRANZ TOREK (New York) said that in discussing the late results of resection of the Œsophagus for carcinoma he would confine his remarks to the resection of the thoracic portion of the Œsophagus. When one considers the late results of this procedure one is interested in the length of time the patient has lived after operation, the degree of comfort or discomfort since operation, the influence on the patient's general health, the question of complications caused by the operation, and the question of recurrence of the disease. He presented a patient, who was operated on March 14 1913, so that in two and a

half weeks from to-day, twelve years will have elapsed, therefore, on the first point mentioned, the length of life after operation, her presence to-day renders favorable testimony

To consider intelligently the other points in this presentation, it will be necessary to outline in a few words what the operation consists in. The thoracic cavity is opened on the left side by an incision through almost the entire length of the seventh intercostal space and the division of four ribs from the seventh up to near the spinal column. This gives ample room for access. The œsophagus is liberated from the diaphragm to the neck and divided between two ligatures beneath the tumor. The lower end is invaginated by one or two purse-string sutures, the upper part, inclusive of the tumor, is exenterated through an incision at the anterior border of the left sterno-cleido-mastoid muscle. Then that portion of the œsophagus above the tumor which is to be retained, is placed antethoracically under the skin, the cut end being sutured to an incision in the skin of the thorax. Anything that is swallowed therefore passes down the œsophagus and out through the incision in the skin, to which the cut end was sutured. To lead the food into the stomach a rubber tube is employed, which bridges the gap from the œsophageal fistula to a gastrostomy opening. The case was described in *Surgery, Gynecology and Obstetrics*,<sup>1</sup> a more extensive article appeared in *ANNALS OF SURGERY*,<sup>2</sup> and a follow-up report in *Archives of Surgery*.<sup>3</sup>

Now, as to the question of comfort, the presence of the foreign material, the rubber tube, causes her neither pain nor discomfort. She eats all kinds of food, it glides down readily after thorough chewing. She is not subjected to the passage of bougies, one of the unpleasant accompaniments of attempts at plastic restoration of the œsophagus, nor is she exposed to the necessity for reoperations, which almost always arises in œsophagoplasties owing to strictures that result in spite of frequent passage of bougies. All she has to do is to replace the rubber tube by a new one once a month and to cleanse it every four or five days.

The third point, the effect on the general health, if judged by this patient, leaves nothing to be desired. She has all these years been about as well as a person of her age can be expected to be. Her digestion is satisfactory, and, as compared with that of a person fed through a gastrostomy tube and funnel, it is only natural that her digestion should be better, as she gets the benefit of the admixture of her saliva with the food. In fact, as she has to chew more thoroughly than an ordinary person, the salivary digestion is apt to be even better than the average.

<sup>1</sup> Torek, Franz. The First Successful Case of Resection of the Thoracic Portion of the Œsophagus for Carcinoma. *Surgery, Gynecology and Obstetrics*, June, 1913.

<sup>2</sup> Torek, Franz. The Operative Treatment of Carcinoma of the Œsophagus, *ANNALS OF SURGERY*, April 1915.

<sup>3</sup> Torek, Franz. Carcinoma of the Thoracic Portion of the Œsophagus. Report of a Case in which Operation was Done Eleven Years Ago. *Archives of Surgery*, vol. 8, No. 1, Part 2.

As regards possible complications due to the operation, we might expect some pulmonary or pleural affection owing to the extensive opening of the chest and the manipulation within it

Lastly, as to the question of recurrence This depends on two conditions, first, the degree of malignancy of the new growth, secondly, the thoroughness of its surgical removal In carcinoma of the œsophagus the degree of malignancy of the lesion on the mucosa, pathologically studied, is low, the most frequent form being acanthoma, the type being embryonal, with prickly cells often missing The adeno-carcinomatous type is less frequent Clinically, the malignancy becomes greater as the lesion extends, in the later stages metastases occur, and when the carcinoma has extended through all the coats of the œsophagus, involvement of the mediastinum, the pleuræ, and the lungs will drag the patient down rapidly Therefore, to avail one's self of the comparative benignity of the lesion, it is necessary to attack it early The other condition for securing freedom from recurrence, the thoroughness of surgical removal, requires that the operation be so planned as to secure good access and proper exposure The transpleural route described secures that access and exposure to a greater degree of certainty than any other, as it exposes the entire thoracic œsophagus The full extent of the lesion cannot always be definitely determined by our diagnostic methods, including roentgenographic study, therefore a previously planned limited exposure of the new growth may turn out to be insufficient In Lilienthal's case of extra-pleural resection the interpretation of the X-ray picture led to an insufficient exposure of the carcinoma and consequent scant resection at one end of the tumor But for this slight error in estimating the necessary extent of exposure Doctor Lilienthal's patient would not have had a recurrence and would be alive now

The late results, as far as recurrence is concerned, therefore, will be good if the new growth is attacked before it becomes clinically malignant, and if the operation is so planned as to permit resection with a good margin

#### To Contributors and Subscribers

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

**ANNALS of SURGERY**

227-231 So. 6th Street

Philadelphia, Penna.

# ANNALS *of* SURGERY

VOL LXXXII

AUGUST, 1925

No 2

## CLINICAL CONSIDERATIONS OF THROMBOSIS AND EMBOLISM\*

BY JOHN A. VIETOR, M.D.  
OF NEW YORK, N.Y.

THE technic of surgery of the present day has advanced to such an exact science that with certain types of operations for certain conditions the post-operative results can be tabulated and recited in terms of percentage. However, there are circumstances which tend to mar these figures and to cause the results to be poorer than the purely technical procedure would indicate. There are accidents which must be seriously considered, which at the present time cannot be discounted and which also cannot be foreseen. Among these accidents thrombosis and embolism are still potent factors as post-operative complications and occur far too often to allow them to be disregarded.

In studying the subject from its early times certain names stand out as epoch-making periods in the theoretical conception of its so far unknown etiology. Virchow's classical work in 1846 to 1856 first pointed out the importance and significance of the slowing of the blood stream as an etiological factor. Following Virchow, Zahn in 1872 first launched the theory that thrombi were due to a localized clumping of the leucocytes, with a secondary fibrin deposit. Eberth and Schimmelbusch later changed this conception to that of the platelet origin. After the study and increased knowledge of bacteriology Vidal and Vasquez ascribed the cause of thrombi to microorganisms as numerous cultures showed microorganisms to be often present in the clot. In 1909, Welch classified and described various types of thrombosis depending on their histological origin, the leucocytic thrombi occurring around acutely infected areas, the fibrinous in the smaller vessels in the hepatized areas of the lung in pneumonia and the hyalinized type from the fibrillated fibrin or coalesced erythrocytes and possibly with leucocytes. Conner reviewing the subject in 1913, emphasized the importance of the relation of the coagulation of blood to the action of the calcium salts and their relationship to prothrombin. He maintained that there was no great increase in the number of platelets, which Wright, of Boston, had discovered clung to the side of the vessel wall as a forerunner to coagulation.

Aschoff's conception that not one condition alone, but a "function of a number of variables," was responsible, is at the present time the most widely accepted theory. These variables are (1) Changes in the blood plasma, i.e. diminished or increased coagulability, (2) changes in the blood elements, i.e. increased or decreased powers of agglutination, (3) changes in the

\* Read before the New York Surgical Society April 22, 1925

blood flow, *i.e.*, changes in the rate, the formation of eddies, etc., and lastly changes in the vessel wall itself

In regard to the etiology, Aschoff believes that important changes in the morphological blood constituents precedes the occurrence of fibrin coagulation. What these changes are at the present time is not understood.

Experimentally various types of thrombosis have been produced by many various methods using foreign bodies, poisons, sera, chemicals, bacterial toxins, tissue extracts, etc., to produce the various types. These experiments led Aschoff to his conclusions that the slowing of the blood stream plus the alteration of the blood elements themselves, especially the platelets, were the chief factors in the production of thromboses.

That infection plays a very definite rôle as an etiological factor cannot be denied. It has been well known for years that thromboses arise in the tissues adjacent to an inflammatory area, and it is also undisputed that due to an infective process thromboses arise in parts far distant from the inflamed area as instanced in the phlebitides of typhoid fever.

Post-operative thromboses manifest themselves in certain localities after certain processes. The veins of the leg, the femorals and the pelvic veins are the most frequent sites clinically. Here, the supine position of the patient allows retardation in the veins of the lower extremities, the femorals lie close under Poupart's ligament and the left iliac vein by its anatomical position is compressed by the arterial trunks, thus all tending to retard the blood stream. Accompanying this retardation of the blood stream there is in a great majority of cases a low-grade infection.

Whether or not the post-operative pneumonia or pneumonitides are embolic in character is still a matter of conjecture although apparently this theory is becoming more and more generally accepted. Certainly the fact that numerous cases arise after local or regional anaesthesia would tend to make one believe that some, at least, can be classified as embolic. Consequently, if it is possible to decrease the occurrence of thrombosis and embolism, it is reasonable to suppose that certain of these pneumonias may be avoided.

The characteristics of these post-operative pneumonias also suggest their embolic character. They vary to a great extent from the typical so-called medical pneumonias. They occur from the first to the fourth day after operation, are ushered in by a rise of temperature from 102 to 103, a dry hacking cough with expectoration rarely rusty or blood-tinged, and a slight rise in the pulse and respiratory rate. On physical examination the patient rarely appears cyanotic or in great distress, tactile fremitus may be increased and there may be small areas of dullness with fine crepitant râles usually heard over the lower posterior chest. Exploratory puncture frequently reveals small amounts of slightly blood-tinged fluid. The X-ray picture showed a typical bronchial pneumonia. The course of this type of pneumonia is, as a rule, from three to four days resolving by lysis with a gradual clearing up of physical findings.

## THROMBOSIS AND EMBOLISM

In regard to fatal pulmonary embolism which may be the end result of thrombosis, little more is known of its etiology. On account of the size, shape and diameter of the embolus as found at autopsy, Aschoff believes that it is always from the femoral vein, although possibly a pelvic phlebitis may exceptionally be the starting place. Clinically, many conditions have been suggested as aiding in its occurrence, namely, faults in the patient, faults in the operative technic, and faults in the operative care.

I have collected and studied the cases of fatal pulmonary embolism occurring on the second surgical division of the New York Hospital for ten years, from January 1, 1915, to December 1, 1924. They are stated in the following table.

TABLE I

No. of operations	12,615	
No. of emboli	21	
Average time of occurrence	13 days after operation	
Shortest time	16 hours after operation	
Longest time	47 days after operation	
Average age of patient	43 years	
Operations	No. of cases	Days after operation
Salpingitis	1	47
Myomectomy	1	2
* Watkins Wertheim	2	18, 16
Hypert. prostate	1	15
* Gall-bladder	6	16 (hrs), 1, 7, 10, 25, 31
* Chr. appendicitis	3	4, 7, 12
* Hernia	2	7, 11
Acute appendicitis	1	3
* Ca. of pancreas	1	31
* Ca. of œsophagus	1	17
* Sarcoma of chest wall	1	14
* Fracture of patella	1	8

\* Autopsy obtained

Autopsies were obtained in nine cases and showed a thrombosis of the femoral vein in four cases. In one case there was a thrombosis of the common iliac vein and the inferior vena cava. Two cases a wound inspection was only allowed so the condition of the femoral veins was undetermined. In the remaining two cases, while a complete autopsy was performed, no existing thrombosis could be demonstrated.

It will be noted from the above chart that those cases that died of a pulmonary embolus gave no clinical sign of a preexisting phlebitis or thrombosis except in the case of carcinoma of the pancreas. In this case the patient had a hopeless condition and was gradually dying of a metastatic growth in his liver. On his thirteenth post-operative day a swelling of his left leg was first noted and on his twenty-seventh day he had a hæmiplegia. He died on the thirty-first day after his operation from apparent cachexia, but at autopsy a large pulmonary embolus with thrombosis of the common iliac and



inferior vena cava was revealed. One case of inguinal hernia complained of a pain in his right leg on his third post-operative day, but periodic examination was negative for clinical evidence of a phlebitis. He died on the eleventh day and at autopsy showed a thrombosis of the right femoral vein.

Heard, quoting figures from the Mayo Clinic from 1912 to 1920, cites 104 cases of fatal pulmonary emboli following 125,164 operations or one to 1203, an average of 0.08 per cent. In this series resection of the rectum gave the largest mortality: 549 operations and 3 fatalities from emboli or 1 to 183. Abdominal hysterectomy was second: 3751 cases and 18 pulmonary emboli or 1 to 208. It is of interest that in both these series the occurrence of pulmonary emboli is insignificant in cases in which the abdominal cavity was not opened.

Schilling in Germany collected 32 cases over a period of 12 years, giving a percentage of 0.12 per cent. Ten of these cases occurred after a local anæsthetic.

The symptoms of large pulmonary emboli are too well known and the diagnosis too self-evident to require any description or elaboration. Treatment is, as a rule, valueless, but cardiac stimulants should be avoided on account of the danger of dilatation of the right heart. Trendelenburg has operated for pulmonary emboli on animals, but the literature fails to reveal any successful operation on humans. Supportive measures rarely give relief although occasionally cases which clinically give the picture of a pulmonary embolus do recover.

In reviewing the number of cases diagnosed clinically as phlebitis occurring on the same service during the past ten years, there was a total of 34 cases, or approximately 1 in 330. These cases occurred after the following operations:

TABLE II

	No. of cases	Days following operations
Fibroid uterus	3	11, 15, 14
Retroversion	1	13
Salpingitis	1	14
Ovarian cyst	1	8
Intra-ligamentous cyst	1	9
Puerp sepsis (no op.)	1	14
Pelvic abscess	1	21
Ca. of the rectum	1	22
Acute appendicitis	5	14, 15, 25, 14, 29
Chronic appendicitis	6	24, 39, 20, 20, 14, 22
Varicose veins of leg	3	14, 8, 6
Hernia	5	13, 3, 24, 27, 11
Gunshot wound of abdomen	1	23
Abscess of leg	1	9
Ca. of pancreas	1	31 (died of pulmonary embolus)
Ulcer of duodenum	1	12
Abscess of mammary gland	1	9
Average number of days		15

## THROMBOSIS AND EMBOLISM

Compared with the cases dying of a pulmonary embolus which showed no phlebitis clinically, it is of great interest to note that of the 34 cases in which a definite phlebitis was diagnosed only one of these had a fatal outcome. Consequently, prophylactic measures tending toward the avoidance of thromboses and emboli should be instituted in order to decrease as much as possible the untoward complications. Various and numerous measures have been suggested, *first*, as to patient, experimentally it has been shown that thromboses occur more readily in rabbits in poor general condition than in healthy ones, so have a patient in good general physical condition if possible. Remove foci of infection as carious teeth, diseased tonsils or infected sinuses, etc. Increase the body fluids by giving water by mouth or rectum or by other methods. *Second*, technic of operation. The position of the patient on the operative table has been a matter of study by numerous observers and various suggestions offered. A position which would tend to temporarily decrease the blood circulation by pressure or obstruction to the venous return should be avoided. The Trendelenburg position has been the subject of condemnation and the overstretching of the spinal column in gall-bladder operations has likewise been condemned. While operating many good suggestions have been brought forward, the avoidance of strong pull on abdominal retractors as emphasized by Clark, care in ligating, the poor control of stasis, traumatization of tissues, too tight suturing and the too free use of cutting needles.

In the post-operative care many further valuable suggestions, which if religiously carried out, might lessen the occurrence of thrombi and emboli. Systematic exercises as advocated by Pool in 1913, which, while affording to the individual patient only such exercises that he or she is able to perform, is a suggestion in the right direction, but unfortunately little followed. The proper care of the intestinal tract to avoid straining of hard-formed feces is important. Some authors attribute the dislodgment of a clot to the passage of hard feces through the sigmoid and rectum over the iliac vessels. Allowing the patient up as early as the fifth post-operative day has also been advocated by some, but it would seem that there are too many other possible complications which would mitigate against the possible advantages gained.

Experimentally Hirudin checks coagulation of rabbit's blood for a period of hours, and Mason in Detroit has prepared tissue extracts with the same end in view. While it would seem impossible to determine in which cases anti-coagulants might be of value, these would be contra-indicated where the danger of oozing after an operation is a serious one.

### CONCLUSIONS

(1) Definite etiology of thrombosis is as yet not fully understood. While due to a "function of a number of variables," two main causes stand pre-eminently forward, changes in the blood plasma, and slowing of the blood stream.

(2) Infection is one process which definitely causes thromboses.

(3) Many post-operative pneumonias are probably embolic in character.

## JOHN A VIETOR

(4) Fatal pulmonary emboli usually occur without warning and without clinical evidence of a preexisting thrombosis

(5) Definite prophylactic measures should in all cases be instituted in the hope of avoiding thrombosis and embolism

### REFERENCES

- Virchow Gesammelte Abhandlungen, Frankfurt, 1856  
Welch Thrombosis and Embolism Albutt System of Medicine, 1909, vol vi, p 691  
Conner Nelson's Loose Leaf Medicine, vol iv, Chapter V  
Heard New Orleans Medical and Surgical Journal, vol lxxvi, April, 1924  
Magnus, Georg Kleinsche Wochenschrift, Berlin, vol cxxiv, Jan 22 1924  
Aschoff Med Klin, 1909, vol xi, p 1702  
Mason Surg, Gyn, Obst, Oct, 1924, vol xxxiv, p 421  
Vera and Loeb Jour Biol Chemistry, vol xiv, p 305  
Caniston Boston Med and Surg Journal, 1908, vol clviii, p 284  
Gibson Med Record, 1909, vol lxxv, p 45  
McCann British Med Jour, 1918, vol i, p 277  
Aschoff Archives Internal Medicine, Nov, 1913, p 503 Lectures on Pathology, P B Hoeber, 1924, p 253  
Pool Post-operative Exercises Jour Am Med Assn April, 1913

# INTRACRANIAL TUMORS AND ABSCESES CAUSING COMMUNICATING HYDROCEPHALUS

BY WALTER E DANDY, M D

OF BALTIMORE, MD

FROM THE JOHNS HOPKINS UNIVERSITY AND HOSPITAL

IN EARLIER publications it has been shown that practically all cases of chronic hydrocephalus\* are caused by a block at some point in the system of spaces in which cerebrospinal fluid circulates. This block, however, is constant neither in character nor in location. A varied assortment of obstructions includes congenital defects and malformations of or affecting the cerebrospinal spaces, congenital and acquired strictures, inflammatory obliteration of the subarachnoid space, tumors, abscesses, tubercles, etc. But regardless of the intrinsic character of the underlying lesion, and regardless of its location, the effect is always precisely the same—a reduction in the absorption of cerebrospinal fluid. The various clinical and anatomical differences in the expression of hydrocephalus, though interesting, are of no fundamental significance. They are but expressions of an underlying cause.

In every case of hydrocephalus the causative lesion can now be demonstrated not only at necropsy, but during life by clinical tests, and most of them could be found, if need be, at operation. Such being true, there is no longer justification for referring to hydrocephalus as “idiopathic.”

It is convenient and useful from the standpoint of therapy to subdivide hydrocephalus into two types (1) *with* communication and (2) *without* communication, depending upon whether or not the lateral cerebral ventricles are in communication with the spinal subarachnoid space. This differentiation of type is easily made by injecting a cubic centimetre of neutral phenol-sulphonephthalein into the spinal canal and testing for the color in the ventricular fluid fifteen to twenty minutes. The presence of the dye in the ventricular fluid at once eliminates the existence of any obstruction within the ventricular system and places it in the subarachnoid space (usually the cisternæ)—communicating hydrocephalus. If the dye does not appear in the ventricular fluid the obstruction must be located at some point in the ventricular system (non-communicating hydrocephalus). Fundamentally, of course, these two types are alike, they differ only in the location of the obstruction. It may be noted in passing that occasionally there are two

---

\* The qualification “practically” is used because of a possibility that thrombosis of the vein of Galen, or its closure from other cause, may result in a continuous formation of fluid. We were able to induce a low-grade hydrocephalus in a dog by a ligature so placed on the vein of Galen that an adequate venous collateral circulation failed to develop. If such a venous obstruction occurs without other complications and causes hydrocephalus in human beings, it must be exceedingly rare. In every necropsy we have carefully inspected the vein of Galen and it has always been patent.

obstructions, both of which may be in the ventricular system, such as at the aqueduct and the basal foramina, or one may be within the ventricular system and the other in the cisterna

This paper is concerned only with the etiology of the communicating type

of hydrocephalus. In previous reports on this subject we have observed only post-inflammatory adhesions and one case of congenital maldevelopment of the subarachnoid space as the cause. In this paper two additional types of lesions are presented — namely tumors and abscesses, or more correctly, the reaction about abscesses. That at least one of the communicating foramina (Magendie and Luschka) at the base of the brain was patent during life, has been shown by the phenolsulphonephthalein test, and at necropsy both by inspection of

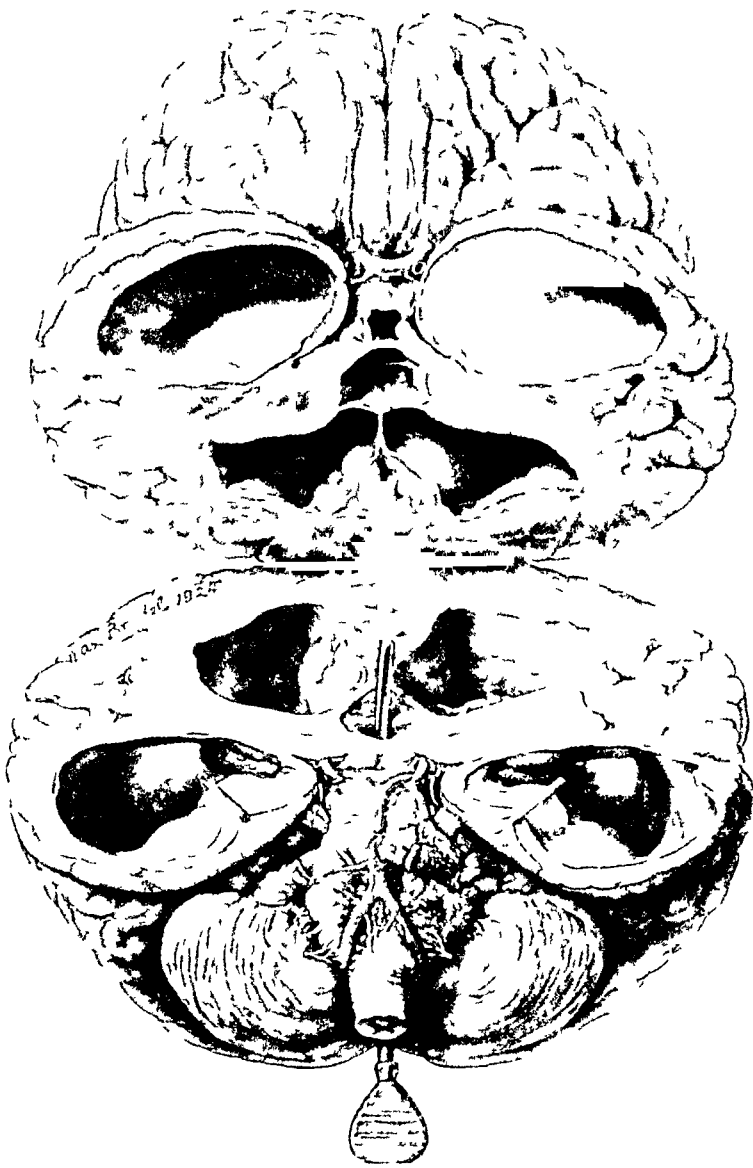


FIG 1 — Drawing by Mr Brodel of the brain in Case I. The tumor can be seen covering the entire ventral surface of the brain-stem. The tumor is a direct outgrowth from the brain tissue. The various nerves pierce the tumor or skirt its edge. Curiously no nerve palsy had resulted. The large probe passing through the foramen of Magendie, fourth ventricle and aqueduct of Sylvius into the dilated third ventricle shows that the tumor has produced no obstruction in the ventricular system. The tumor has pushed the basilar artery away from the brain-stem, in one place near its centre the artery is partly covered by the tumor.

these foramina and by the passage of ink into the fourth ventricle. In one patient, an infant, an infiltrating glioma (possibly of congenital origin) covered the ventral surface of the pons and medulla (Fig 1), in another a boy of six, the lesion was also a glioma and quite similarly placed (Figs

3, 4 and 5), and in a third infant two symmetrically placed abscesses at the tip of each temporal lobe were connected by a dense bridge of inflammatory tissue (Fig 7). In each instance the location of the obstruction and its impermeability were demonstrated by intraspinal injections of India ink (under pressure) before the necropsy was begun. In no instance did the color pass the block. In cross-section, each lesion involved the entire exposed ventral and lateral surfaces of the brain-stem, thereby obliterating peripheral as well as central portions of the cisternæ.

CASE I—A baby of five months, referred by Dr J G Lemmon, of Akron, Ohio, exhibited no unusual features of hydrocephalus (Fig 2). Birth was at term, the delivery was spontaneous and easy. The infant thrived after birth and at three and a half months was able to hold up its head, but at four months it was brought to Doctor Lemmon because "it did not seem so well." The enlargement of head was first noticed at that time and progressed rapidly, it was no longer able to hold up its head. There had never been a history of an acute illness, of paralysis or convulsions. The anterior fontanelle was large, bulging and tight, all cranial sutures were widely separated. Head measured 46.5 cm. in circumference. No asymmetry or other abnormalities could be seen.



FIG 2—Patient (Case I) showing hydrocephalus caused by the tumor arising from the brain-stem (Fig 1)

Phenolsulphonephthalein test: one cubic centimetre of phenolsulphonephthalein was injected into the lumbar spinal canal. After twenty minutes fluid was aspirated from a lateral ventricle and showed the dye in concentration which matched a 20 per cent standard colorimeter solution, two hours later the color had increased so that undiluted it matched an 80 per cent standard solution. After three hours, 8 per cent of the phthalein was recovered from the urine (spontaneous voiding). A second specimen of urine obtained three hours later contained an equal amount.

It was evident, therefore, that we were dealing with a case of communicating hydrocephalus. There was no reason either from the history, examination, or clinical tests, to suspect a tumor as the obstructing lesion. A few hours following removal of the choroid plexus (through a ventriculoscope) the patient died. When the occipital lobes were exposed no fluid was found in the subarachnoid space of either side.

Necropsy showed a diffuse glioma involving most of the ventral and lateral surfaces

of the pons and medulla (Fig 1) Both foramina of Luschka were occluded but the foramen of Magendie was patent The aqueduct of Sylvius and the third and fourth ventricles were greatly enlarged The lateral ventricles were greatly enlarged

India ink injected at the beginning of the necropsy passed freely into the lateral ventricles but stopped sharply at the caudal margin of the tumor underlying the brain-stem The accompanying drawing by Mr Brodel (Fig 1) graphically demonstrates the patency of all the ventricular channels (the large probe passing through the iter, fourth ventricle, the foramen of Magendie) and the high grade of hydrocephalus of the lateral ventricles

CASE II—A colored boy of six years entered the Johns Hopkins Hospital because

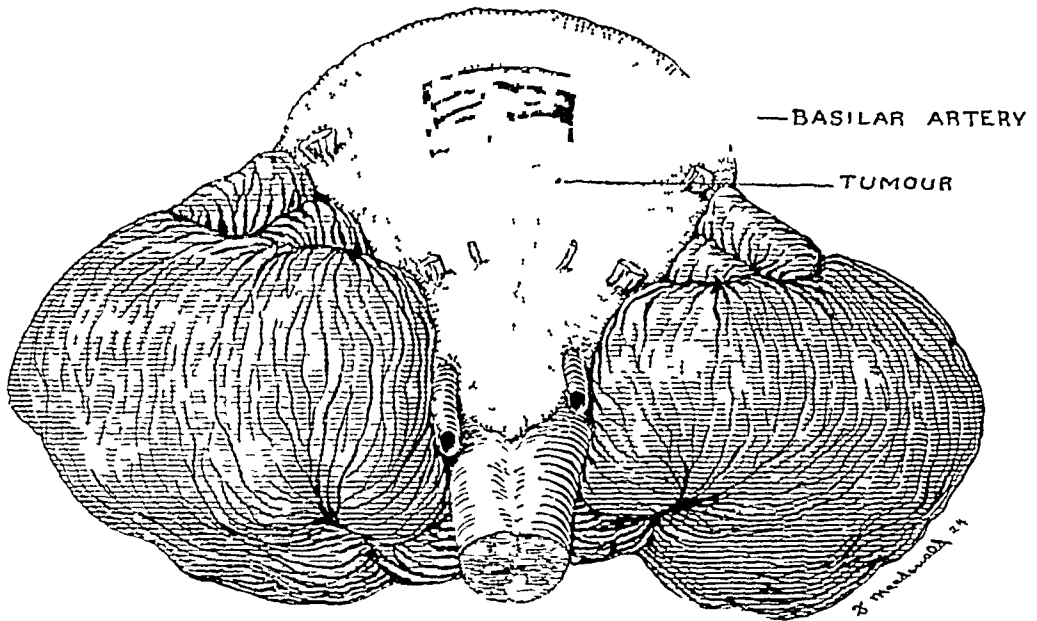


FIG. 3—Drawing of an extensive tumor covering the ventral surface of the brain (Case II). In this case the basilar artery is entirely covered by the tumor and the vertebral arteries are seen entering at its lowermost parts. A window has been made in the tumor by Doctor Macdonald to show the basilar artery beneath.

of a rapidly developing paraplegia involving only the legs. Prior to his present illness he had apparently been well. He played normally with other children and offered no complaints. His mentality did not appear abnormal. He walked and talked at the usual age. One year previous to our examinations he first complained of a pain in the left leg above the knee and shortly afterward a backache developed in the lumbar region. A scoliosis and kyphosis appeared and increased. Soon a foot-drop developed, then the power of the left leg was affected. Nine months ago he began using crutches. The right leg then became paralyzed and for several weeks he had been bedfast. Control of urine was lost, several times it reappeared only to be lost again. The backache caused him great misery at night.

No complaints had ever been made referable to the head. The objective findings were those of a spinal cord lesion, presumably a tumor because of the gradual progression of signs and symptoms. There was incomplete flaccid paralysis of both legs but more marked on the left. However, there was some evidence of spasticity of certain muscle groups of the left leg—notably the hamstrings. A fairly definite bilateral sensory level could be made out at the first lumbar segment. The deep reflexes were normal on the right and absent on the left. A faint ankle clonus could be elicited at times on the left, not on the right. Plantar stimulation produced no response. The first and second lumbar spines were tender to pressure. The above signs and symptoms seemed to clearly indicate that the tumor occupied the lumbar enlargement and roots of the cauda equina.

## INTRACRANIAL TUMORS AND HYDROCEPHALUS

Another objective but incidental finding in this case caused us much concern in the diagnosis. His head was very large. All the cranial sutures were widely separated (X-ray and Macewen's sign). The X-ray also showed an extraordinary degree of convolitional atrophy of the skull. The sella turcica was three times the normal size, though the posterior clinoid processes were still intact.

The eye-grounds were considered to be negative, though possibly the retinal veins were full but not tortuous. He had not now, nor had he ever complained of headache, dizziness or convulsions. There was no hemianopsia or other disturbance of vision. Our usual neurological examinations failed to find any additional signs by which an intracranial lesion could be located. That he had hydrocephalus could not be doubted,

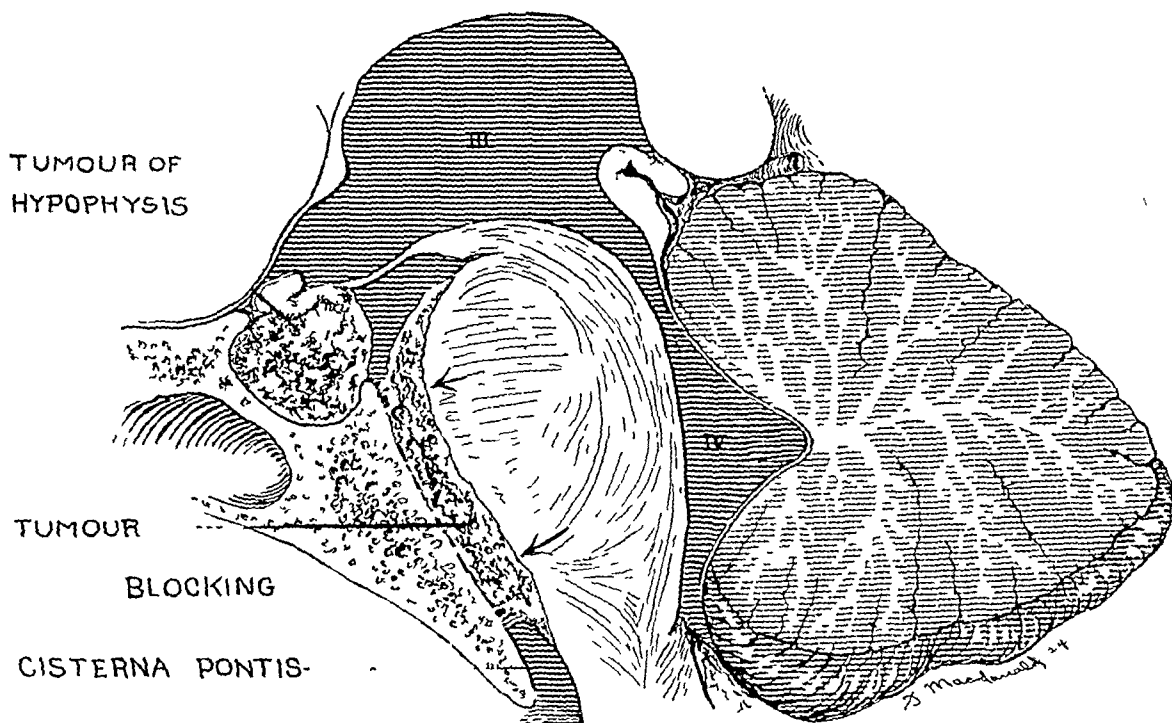


FIG. 4.—A mid-sagittal drawing in semi-diagrammatic form to show the extent and position of the tumor shown in Fig. 3. In both this case and the preceding one a spinal injection of India ink stopped at the lower margin of the tumor for the cisterna was completely blocked. In this patient the tumor in the region of the hypophysis played no part in the production of the hydrocephalus.

and the deep convolitional markings of the inner table of the skull (roentgenographic findings) indicated that the hydrocephalus was not at a standstill.

Since the paraplegia could only be accounted for by a spinal cord tumor of some kind, it was necessary to assume the existence of a second tumor or other type of lesion to explain the hydrocephalus. Nor did it seem possible that the lesion which had enlarged the sella turcica could account for the hydrocephalus. In the first place, it was too far forward to obstruct the cisternal trunk, and in the second place, the normal vision made it appear that the tumor, if such it were, had broken through the dural envelope of the sella.

A spinal injection of air was made with the hope of obtaining more information concerning the spinal lesion. The spinal cord tumor was sharply localized by the level of air in the skiagram, but no air reached the cranial chamber.

Quite unexpectedly, however, additional proof of the existence of the intracranial lesion and something of its character, was disclosed. Below the level of the tumor the sheath of each spinal nerve was distended into a distinct pouch about one centimetre in length. Such a finding indicated that the intraspinal pressure, which is but a transmitted intracranial pressure, must have been very high prior to the spinal block which had evidently only recently developed.

With proof that a spinal block existed, it was not clear that trepanation for ven-



tricular puncture and phthalein test would throw additional light on the problem. After removal of the spinal cord tumor (a fibromyxoma) cerebrospinal fluid could be withdrawn in very large quantities from the spinal canal, showing that the hydrocephalus was surely of the communicating type. Probably the same occlusion should have been suspected from the dilated nerve sheaths which were demonstrable in the pneumogram. No attempt was made to treat the intracranial condition. The patient later came to necropsy. A diffuse glioma enveloped the entire exposed portion of the brain-stem. Strands of the tumor extended to the sella turcica and possibly joined by a strand another



FIG. 5.—Drawing to show the circular extent of the tumor surrounding the mid-brain. Here the cisterna is entirely closed and the aqueduct is patent. Just as in the preceding case a probe could be readily passed through the foramen of Magendie, the fourth ventricle and the iter.

tumor (the patient's third tumor) in the sella turcica. This sellar tumor seemed an entirely different growth and was attached to the sheath of one optic nerve, the pituitary body was intact and pushed downward and to one side of the sella.

India ink injected into the spinal canal passed through the foramen of Magendie, the fourth ventricle, the iter, third ventricle and both lateral ventricles, but stopped abruptly at the lower margin of the tumor beneath the brain-stem.

CASE III.—An infant of six weeks was referred by Dr. J. L. Powe, of Hartsville, S. C., with an obvious diagnosis of hydrocephalus. Labor was difficult, instruments being used. The baby breathed only after heroic efforts had been applied. It was jaundiced during the first week and ran a fever throughout the first two weeks and during this time there was vomiting and great difficulty in feeding. For ten days the mother noticed that the baby's head would frequently jerk and draw far backwards. When three weeks old the head was unusually large. When one month old he had a crying spell in which the head was thrown back. Since then there have been many spells lasting a few minutes in which the body was in strong opisthotonos and he would cry out with pain. It has been impossible to gain weight; the little patient now being greatly emaciated. For a week it had not used either arm or leg normally.

The head was greatly enlarged measuring 40.5 cm. in circumference. The anterior

## INTRACRANIAL TUMORS AND HYDROCEPHALUS

fontanelle measured  $15 \times 16$  cm. No reflexes were obtainable. Examination of the spinal fluid showed 100 cells per cubic millimetre—all polymorphonuclear cells—and a heavy globulin precipitate.

Phenolsulphonephthalein test (intraspinal injection). Free communication between both lateral ventricles and the spinal subarachnoid in fifteen minutes, the ventricular color (undiluted) corresponding with a standard 40 per cent tube, 10 per cent excretion in the urine in two and a third hours.

The diagnosis of an underlying inflammatory lesion seemed certain. Our presumptive diagnosis was hydrocephalus resulting from meningitis.

Necropsy. India ink was injected into the spinal canal. The pathological findings were entirely unexpected (Fig 6). At the tip of each temporal lobe was a well-encapsulated abscess, which, while attached to the adjacent dura, could be removed, intact, with the brain. The abscesses, each the size of a golf ball, were of almost exactly the same size,  $4 \times 4$  cm., and in precisely the same location. Unfortunately the organism could not be identified as the body had been embalmed with formalin before the brain was removed. Between the two abscesses was a dense broad band of subacute inflammatory tissue, and at the caudal end of this inflam-

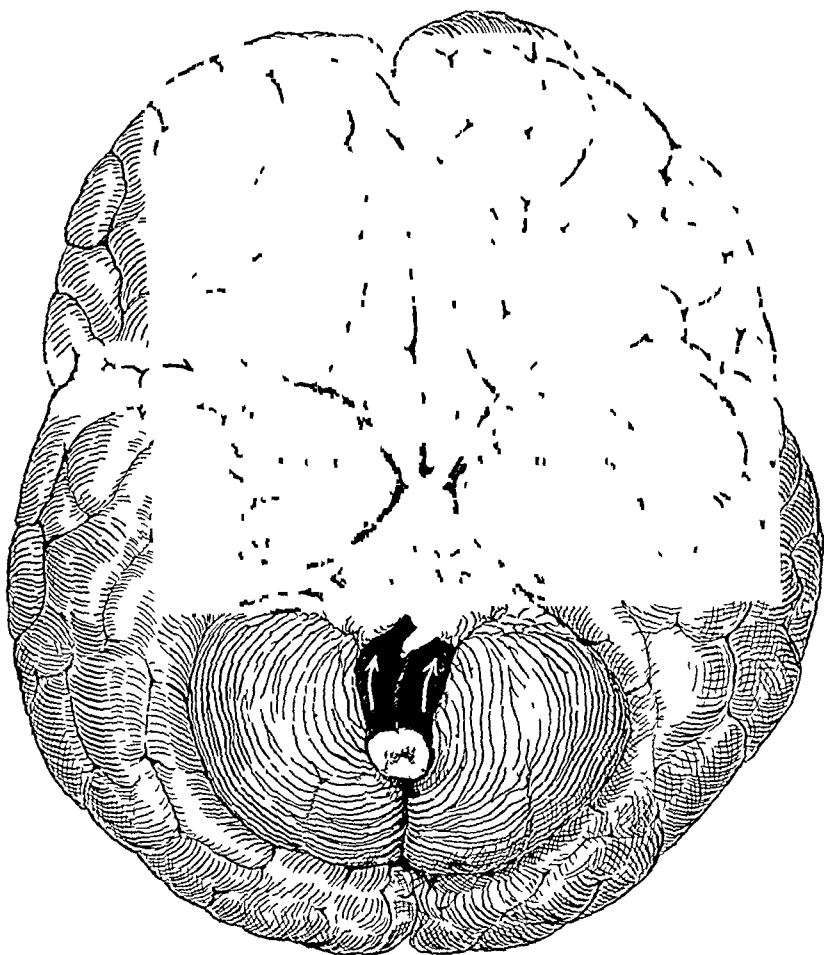


FIG 6—Sketch of the base of the brain in which an abscess was present at the tip of each temporal lobe. They were adherent to the underlying dura. Between the abscesses is a dense inflammatory mass entirely concealing the underlying vessels, and obliterating the cisternæ chiasmatis and interpeduncularis, as well as the cisterna under the pons and mid-brain. The black covering over the medulla has resulted from an injection of ink into the spinal canal at necropsy, the ink stopping at the obstruction in the cisterna caused by the dense, subacute inflammatory mass.

matory band the ink injection had stopped abruptly. The foramen of Magendie and both foramina of Luschka were patent. All of the ventricular channels were unobstructed and greatly dilated. But little brain tissue remained in either hemisphere owing to the great ventricular distention.

From the history of jaundice, fever, and attacks of opisthotonos, all present almost immediately after birth, it seems probable that these abscesses were of intra-uterine origin. The inflammatory band and not the abscesses, *per se*, were responsible for the hydrocephalus.

In each of these three cases the cisterna pontis was completely blocked. In an earlier publication<sup>1</sup> adhesions in this region were found and suspected to be the etiological factor in the production of the hydrocephalus. Later, it was demonstrated by experiments on dogs<sup>2</sup> that when an impermeable band

of adhesions was constructed around the pons or mid-brain (occluding the cisterna), hydrocephalus of the communicating type followed. In these experiments and in human cases which have since come to autopsy,<sup>3</sup> the line of obstruction has been graphically outlined by the sharp level at which India ink is arrested when injected intraspinously. To understand why an obstruction in the cisterna pontis should cause hydrocephalus, it is only necessary to know the anatomy of the cerebrospinal spaces, the circulation of the cerebro-

Left and right foramen of Monro

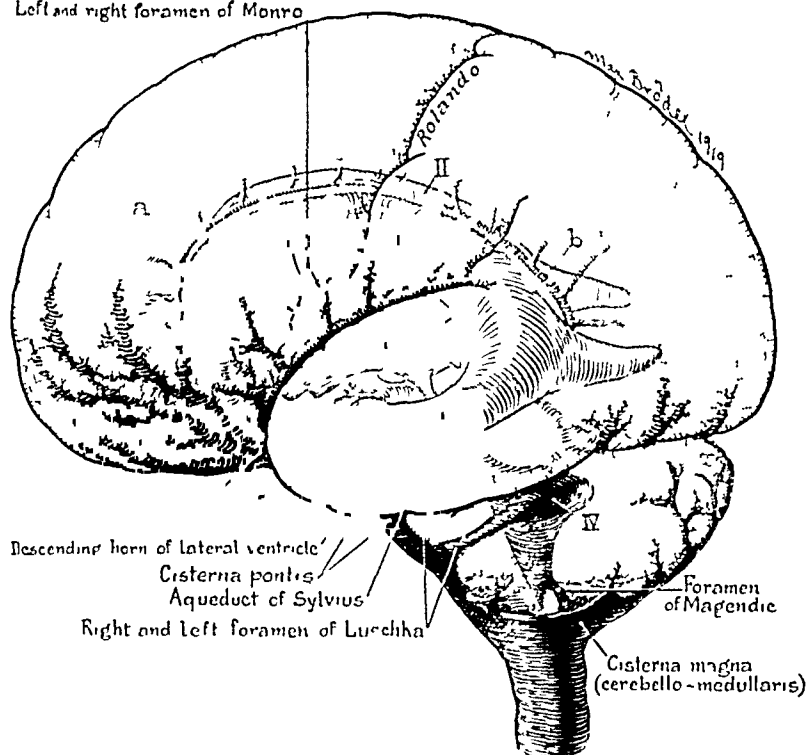


FIG 7—Diagram of the circulatory system for cerebrospinal fluid. The obstruction causing the hydrocephalus in each of the three preceding cases was in the subarachnoid space at the cisterna pontis. It is clear that fluid passing out of the ventricle can therefore not pass over the cerebral hemispheres where it is normally absorbed and this reduction in the absorption of cerebrospinal fluid causes hydrocephalus of the communicating type—that type in which the ventricles communicate with the spinal canal.

and not into the dural sinuses or through special structures such as the Pacchionian granulations). The cisternæ beneath the brain-stem together serve as a conduit, which is the only communication between the cisterna magna (into which all the ventricular fluid is poured through the foramina of Luschka and Magendie) (Fig 7). A block in the cisterna pontis or another part of the conduit of cisternæ, whether by adhesions, an experimental band, tumors, or an inflammatory band, prevents the passage of fluid to the great absorbing area and causes the fluid to dam back to its source—hydrocephalus.

The long duration of hydrocephalus in Case II without symptoms makes us feel that the hydrocephalus was of slow development—possibly that the obstruction of the cisterna pontis was of gradual formation. When the transverse extent of the cisterna pontis is compared with that of the aqueduct of Sylvius, it is evident that a much longer time may be required for its

spinal fluid, the place and manner of formation and absorption of cerebrospinal fluid. Briefly summarized the necessary facts are as follows: Cerebrospinal fluid forms in the ventricular system (from the choroid plexuses) but does not absorb there. Cerebrospinal fluid absorbs in the subarachnoid space (directly into the capillaries in every part of the subarachnoid space,

## INTRACRANIAL TUMORS AND HYDROCEPHALUS

complete occlusion by a tumor's growth. Under such conditions the manifestations of hydrocephalus would surely be less fulminating. That partial closure of the cisterna pontis may be tolerated without causing hydrocephalus with communication, is demonstrated in cerebellopontile (acoustic) tumors. Often less than half of the transverse extent of the cisterna pontis remains when these tumors are found at operation or necropsy, but hydrocephalus does not result until the tumor has occluded the aqueduct of Sylvius. That the iter is obstructed from these tumors, can easily be demonstrated by injecting indigocarmine into a lateral ventricle at the beginning of the cerebellar operation, when the cisterna magna is exposed the fluid will be clear. Further proof that the obstruction is at the aqueduct and not in the cisterna pontis lies in the fact that pressure in the posterior cranial fossa can be relieved by tapping the lateral ventricle, whereas if the iter were patent and the cisterna pontis obstructed, all possible relief of pressure in the posterior fossa would be obtained by the release of fluid from the cisterna magna.

### SUMMARY

Pathological evidence is offered to show that hydrocephalus of the communicating type may be caused by tumors and abscesses when so situated that they obstruct the cisternal conduit under the brain-stem. Post-mortem injections of India ink proved the cisterna pontis to be completely blocked in each case. The cause of hydrocephalus in these cases is precisely the same as in the more common instances resulting from adhesions after the spontaneous cure of meningitis. All cases of hydrocephalus, whether of the communicating or non-communicating type, have fundamentally the same underlying cause, an obstruction in the system of spaces through which cerebrospinal fluid circulates. The result of any such obstruction is a reduction of the spaces in which cerebrospinal fluid is absorbed.

### BIBLIOGRAPHY

- <sup>1</sup> Dandy, W. E., and Blackfan, K. D. Internal Hydrocephalus. An Experimental, Clinical and Pathological Study. Second paper. *Am Jour Dis Child*, 1917, vol. xiv, p. 424.
- <sup>2</sup> Dandy, W. E. Experimental Hydrocephalus. *ANNALS OF SURGERY*, 1919, vol. lxx, p. 129.
- <sup>3</sup> Dandy, W. E. The Cause of So-called Idiopathic Hydrocephalus. *Johns Hopkins Hosp Bull*, 1921, vol. xxvii, p. 67.

## LENGTHENING THE SOFT PALATE IN CLEFT PALATE OPERATIONS\*

By GEORGE M. DORRANCE, M.D.

OF PHILADELPHIA, PA.

FROM THE SURGICAL DEPARTMENT OF THE THOMAS EVANS INSTITUTE, UNIVERSITY OF PENNSYLVANIA

THERE is a distinct percentage of cleft palate cases in which, even though the operation succeeds in closing the cleft, fail from a physiological standpoint in correcting the speech of the individual. The reason for this failure

to aid in phonation is the fact that the soft palate is unable to come in contact with the posterior pharyngeal wall.

An ideal cleft palate operation is one that will permit the patient to speak normally and at the same time close the defect in the palate. While both may be accomplished in a certain percentage of cases, we are all aware that there is a distinct type of case with a short palate in which the speaking voice has not been helped.

I have attempted in this proposed operation of mine to first obtain a sufficient length of palate to insure good phonation and later on attempt to close the hard palate.



FIG. 1.—Modified from Brophy's book.  
Incision to release the hard palate.

I advise this type of operation on all cases where a short soft palate will result from any operations hitherto described, for example the Langenbeck. Despite the fact that most operators prefer doing their operations before the second year, in my opinion the best time to operate where we wish to lengthen the soft palate is from the fourth year on. I find that from the fourth year on the structures of the hard and soft palate contain more fat and lymphoid tissue and will stand manipulation much better than in the younger child.

My anatomical studies, both on the normal and the cleft palate, have made it quite clear to me that if the increased length is to be accomplished, it must be obtained by releasing the anterior attachment of both the hard and the soft palate. To release the structures of the hard palate, I make an incision as shown in Fig. 1, at the same time freshening the edges of the cleft. I then raise the flaps as shown in Fig. 2. These flaps contain all the structures down to and including the periosteum over the hard palate. The elevation of this flap is continued until the border of the hard palate is reached as shown in Fig. 3, the attachment of the palatine aponeurosis of the hard palate is divided. On reaching the tuberosity of the maxillary bone it will

\* Read before the Philadelphia Academy of Surgery, April 6, 1925.

Fig 2 —Palatal flap raised

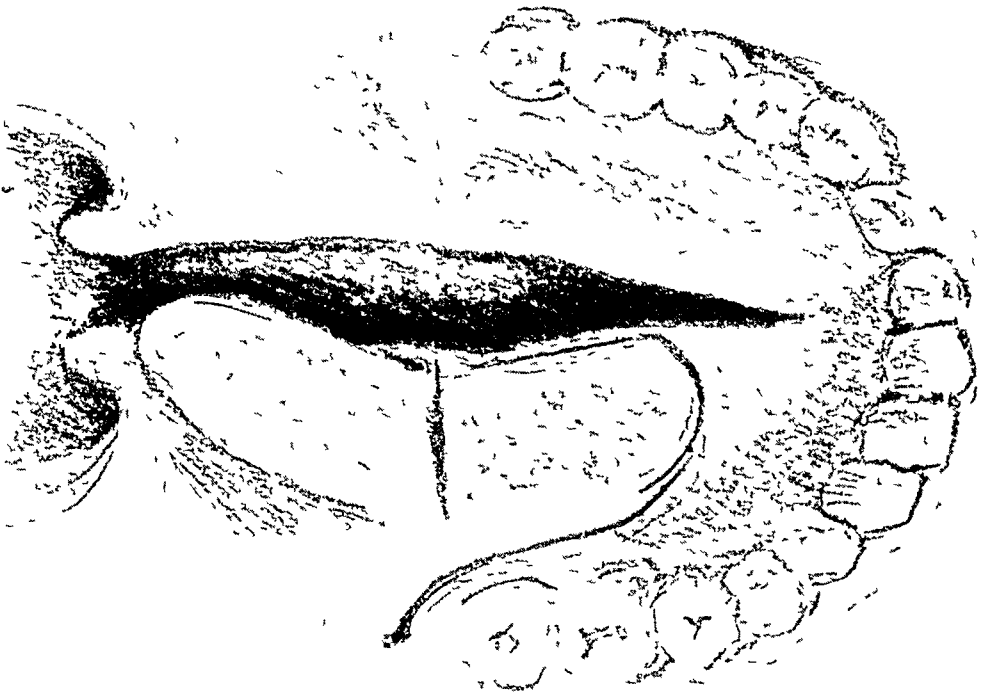
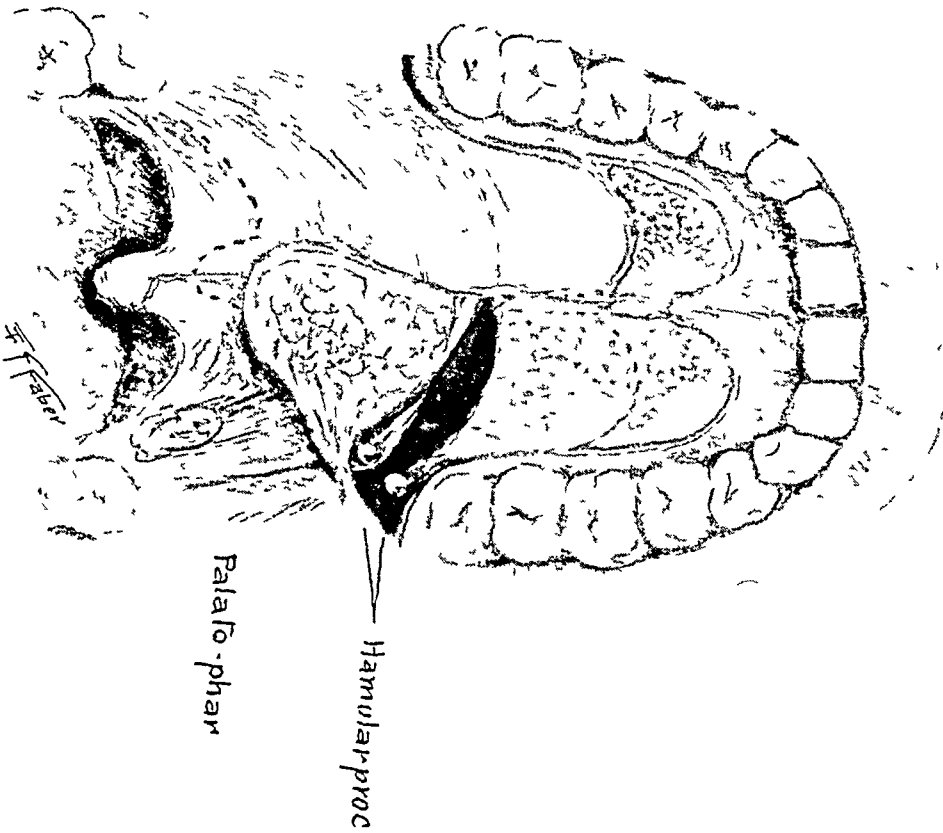


Fig 3 —Hard palate completely exposed



be found that there is still some structure which prevents the palate from falling backwards. This structure is the tendon of the tensor palati muscle. If the hamular process around which this muscle turns at a right angle is broken off the divided portions will be drawn downward by the pterygo-pharyngeus muscle—this muscle being a much stronger and larger structure than is usually described. After this hamular process has been fractured you dislocate the tendon of the tensor palati muscle, thus changing its direction so that instead of forming two sides of a right angle triangle it will form the hypotenuse and as shown in Fig 4, and will allow the lengthening of this muscle and transpose it from a tensor into a levator muscle. This can be demonstrated on any cadaver. After the above procedure has been performed on both sides, you will gain one-half to three-quarters of an inch lengthening and there will be found to be less tension than under the Langenbeck operation. The two flaps will be sutured together, as shown in Fig 5 using whatever suture you especially desire. The anterior edge of these flaps will have a tendency to fall downward. To hold them in place suture them to

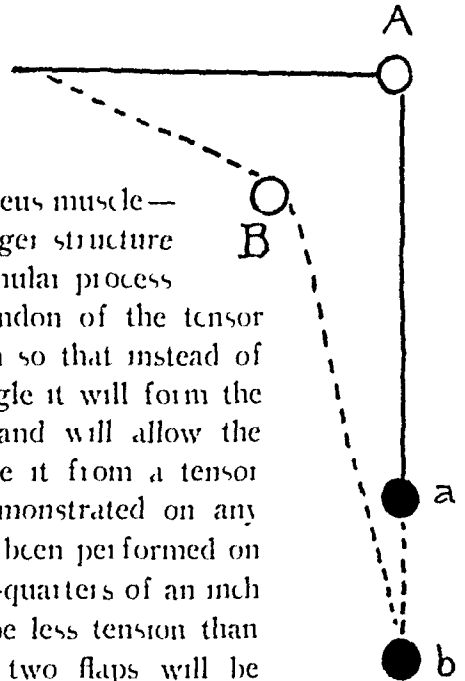


FIG 4 — Alteration in direction of tensor palati muscle

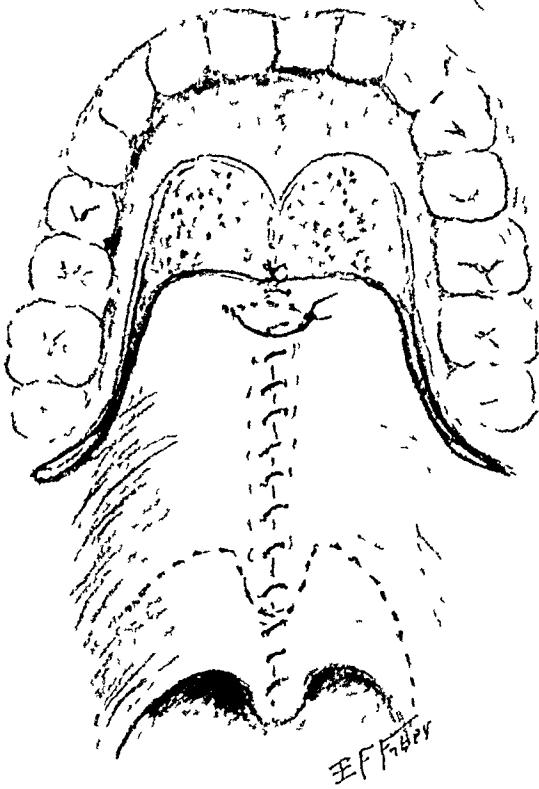


FIG 5 — Note increased length of palate below dotted line

either the remains of the septum or the horizontal plate of the palate bone. While this operation gives you the desired lengthening as shown in Fig 5, it leaves a defect in the anterior portion of the hard palate. This is later closed by means of a flap.

In one case the palate was so short that my colleague, Dr. LeRoy Johnson, Professor of Orthodontia at the University of Pennsylvania felt that no operation was justifiable. As he expressed it, "You will only have a stiff palate which will not close off the opening." Nevertheless, after the operation in this case one will see that the palate comes in contact with the posterior pharyngeal wall, shutting off the mouth

## LENGTHENING THE SOFT PALATE

from the nose There is a point I have been asked about a number of times Does not this method predispose to sloughing of the flaps ? In the cases I have observed so far, I have noted less blanching of the flaps than in my usual cleft palate operations There has been no sloughing The blood supply comes in through the tonsillar plexus It has always been my contention that in a correctly performed Langenbeck operation the posterior arteries are divided

I thank Dr Addinell Hewson for the many courtesies he has extended and the help he has given me in the Anatomical Laboratories of the Post-graduate Department of the University of Pennsylvania



# EPIGASTRIC PAIN A SYMPTOM OF OESOPHAGEAL OBSTRUCTION\*

By PORTER P. VINSON, M.D.

OF ROCHESTER, MINN.

FROM THE SECTION ON MEDICINE, OF THE MAYO CLINIC

IN THE differential diagnosis of pathologic processes producing epigastric pain, disease in the oesophagus is usually overlooked, and yet pain in the upper abdomen as a symptom of oesophageal obstruction, particularly cardiospasm, occurs sufficiently often to warrant the consideration of every careful surgeon.

Pain may occur in the epigastrium during the course of an oesophageal cancer involving the cardia, but considerable dysphagia is usually present before the onset of the pain. In cases of oesophageal carcinoma, regardless of the location of the lesion, pain rarely occurs early, and errors in diagnosis are therefore infrequent. In a small number of cases pain may be the first symptom. In a few such cases that have come under my observation a previous diagnosis of disease in the gall-bladder had been made and the patients had been subjected to an abdominal exploration. However, errors in diagnosis in this group are not nearly so frequent as in cases of cardiospasm.

Upper abdominal pain, usually located high in the epigastrium, occurs in about three-fourths of the cases of cardiospasm, and it may be of such severity that it simulates very closely the pain of gall-stone colic or that of angina pectoris. The initial symptom of cardiospasm may be a severe pain in the epigastrium with radiation to the back, to the throat, or into the ears. It may arise independently of deglutition, and the patient frequently requires a hypodermic of morphin for relief. Such severe attacks may come at frequent intervals for months or even years before there is any suggestion of an obstruction in the oesophagus to the passage of food. One of my patients had had severe attacks of this type for fourteen years before the onset of dysphagia. Before the dysphagia begins, the Röntgen-ray examination rarely reveals any obstruction at the cardia, and unless a thick acacia mixture is used as a vehicle for the barium, the obstruction may not even be noted later in the disease.

The occurrence of mild dysphagia during the course of disease in the gall-bladder, because of a secondary spasm at the cardia, adds to the difficulty of differentiation. The greater frequency of the attacks without jaundice and without residual tenderness in the region of the gall-bladder and the presence of slight dysphagia are the chief points in the differentiation of cardiospasm from acute cholecystitis. In certain cases, a definite differential diagnosis is impossible in the early stages.

The differentiation of the pain of cardiospasm from that of angina pectoris

---

\* Submitted for publication April 17, 1925

## EPIGASTRIC PAIN IN ŒSOPHAGEAL OBSTRUCTION

can usually be made without difficulty, if the heart is thoroughly investigated. One of the patients suffering from cardiospasm also had angina pectoris and gall-stone colic, but the findings relative to each condition were so characteristic that they could be easily recognized as independent entities.

The two cases herewith presented illustrate how the pain of cardiospasm may be confused with that of disease in the gall-bladder.

CASE I—A woman, aged fifty-three, came to the Clinic, May 6, 1919, complaining of having had attacks of epigastric pain for four years. The pain would begin in the pit of the stomach and usually radiate toward the right side and to the back between the shoulders. Vomiting had accompanied two of the attacks. The attacks were not accompanied by jaundice. There had been intervals of from two to four months between the seizures. There was also a sensation in the lower Œsophagus as of food not passing readily into the stomach, and the patient attributed some of the attacks to the bolting of her food.

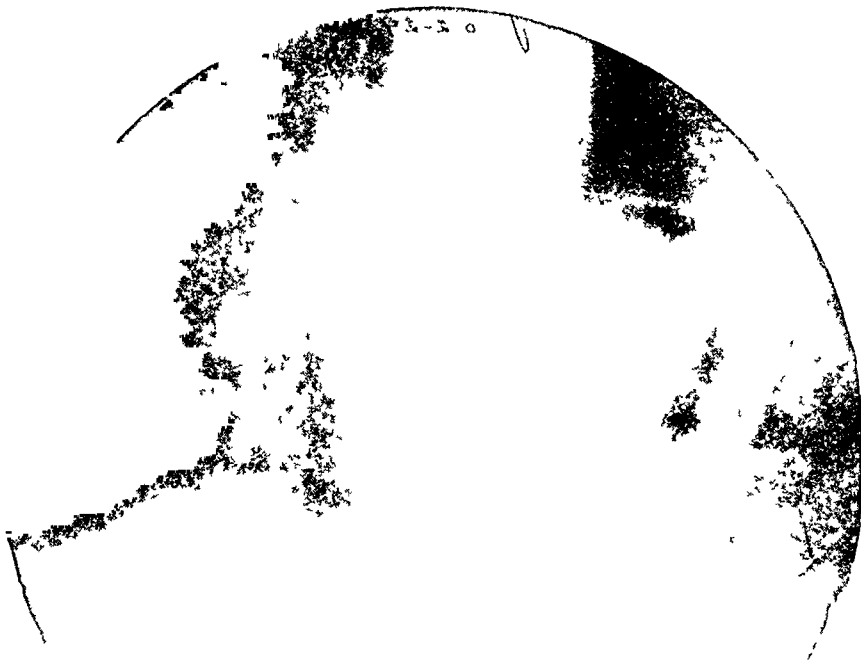


FIG 1—Cardiospasm. Moderate dilatation of Œsophagus. (By courtesy of Dr W. A. Kickland, Ft. Collins, Colorado.)

An ordinary examination of the stomach failed to reveal any evidence of disease, and a test-meal was withdrawn from the stomach without evidence of obstruction to the passage of the stomach tube. The general examination of the patient was negative save for slight tenderness over the region of the gall-bladder, an apparent enlargement of the liver and small adenomas of the thyroid, without hyperthyroidism.

Very little consideration was given to the history of dysphagia and a diagnosis was made of chronic cholecystitis. Operation revealed a rather thick-walled gall-bladder without stones, and there was definite enlargement of the liver with considerable chronic hepatitis.

The patient was fairly comfortable for eight or nine months after the operation, but when she returned for reconsideration, November 17, 1920, the symptoms were about as severe as at the previous visit. Because of her inability to remain for complete study, a thorough examination could not be made.

On account of the increasing severity of the attacks and the necessity for using hypodermic injections of morphin for their relief, the patient returned for reexamination.

February 6, 1925 and at this time another ordinary Rontgen-ray examination of the stomach failed to show any evidence of disease. There was again no obstruction at the cardia to the passage of a stomach tube. At this time there was no relation of the pain to the ingestion of food, but there was still a definite sensation in the œsophagus that food did not pass into the stomach without considerable hesitation.

A special Rontgen-ray examination of the œsophagus revealed an obstruction of the barium meal at the cardia, which was probably the result of spasm. The patient was advised to have the cardia stretched with a hydrostatic dilator, but she declined to remain for treatment.

It is interesting to note that the pain from cardiospasm as well as dysphagia, is relieved by a thorough stretching of the cardia. The act of dilating often reproduces the type of pain experienced during the course of the disease.

CASE II—A man aged forty-three came to the Clinic April 10, 1922, stating that he was perfectly well save for heart-burn at times and an occasional stomach-ache. This had continued from the age of twenty or thirty years until October, 1921, when he was awakened about midnight by a severe epigastric pain which lasted off and on for two and one-half hours, it would last from ten to fifteen minutes and be followed by a free interval of about the same length of time. A diagnosis of gall-stones was made, and because of an idiosyncrasy to morphin it was necessary to administer chloroform. After this time the patient was well until February, 1922 when there was a second and even more severe attack. There was no jaundice following either attack. After such seizures a feeling of fullness remained in the stomach, and at times there was very slight difficulty in swallowing liquids. A Rontgen-ray examination of the stomach was made with negative results, but the patient said it was difficult for him to swallow the barium mixture. A diagnosis of chronic cholecystitis with cholelithiasis seemed warranted, and operation revealed a gall-bladder filled with small stones.

About two weeks after the operation the patient had a third attack of pain and dysphagia became more and more noticeable, more marked with swallowing liquids than solid food. Mild epigastric pain occurred often. A Rontgen-ray examination made at the patient's home revealed a definite cardiospasm with moderate dilatation of the œsophagus and he returned to the Clinic for treatment February 16 of this year (Fig 1).

On stretching the cardia with a hydrostatic dilator the previous type of pain experienced was reproduced but was not severe enough to necessitate an anæsthetic. Dysphagia was completely relieved by the stretching and the patient returned home after seven days' observation.

It is of course, difficult to determine that the first two attacks of pain were not due to gall-stones, but subsequent events possibly warrant the conclusion that the cardiospasm had been responsible for all of the patient's symptoms and that the disease in the gall-bladder was incidental.

# IMPROVED GOITRE TECHNIC

By JOSEPH L. DeCOURCY, M.D.

OF CINCINNATI, OHIO

THE following discussion is based upon 1432 thyroidectomies performed during the past five years by myself and associates at the DeCourcy Clinic, and is intended primarily as a technical contribution. While pre-operative judgment is important in goitre surgery (whether to ligate, whether to do double ligation, whether to remove one or both lobes, whether to leave wound

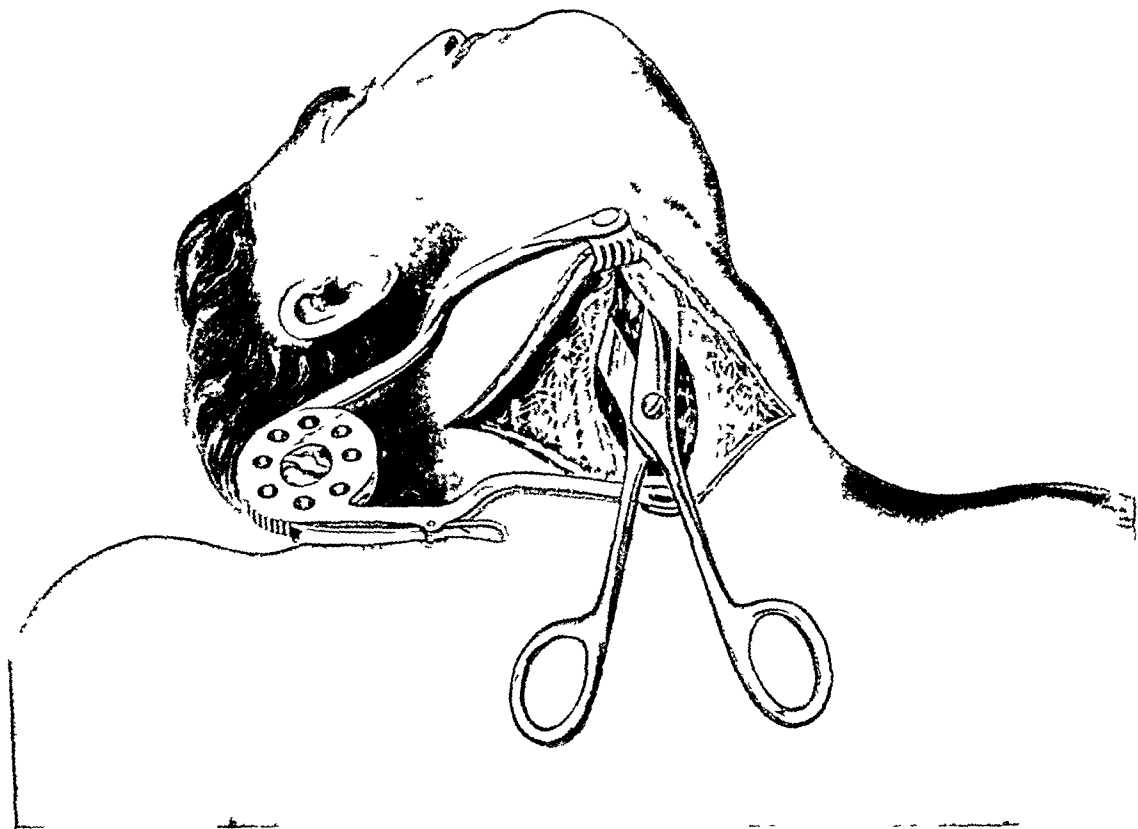


FIG. 1.—After median incision is carried through muscles and fascia down to gland, scissors are inserted and spread apart thus separating the thyroid gland from the overlying structures.

open) and has reduced the operative mortality to nil in trained hands, still this judgment will be of no value unless the operation be performed skilfully and with dispatch.

There is no operation which lends itself more beautifully to technical grace than does thyroidectomy. Types of goitre vary and may cause slight variations in technic, but the underlying principles are the same in all cases.

The incision which we use is placed in the lower crease of the neck. This crease is readily seen in almost every neck and invites the incision. It is preferable to lower incisions because of the looseness of the neck which causes the edges to fall together.

The muscles are separated by a median line incision through the fascia

After the incision is carried down to the gland, it is enlarged upward and downward from the thyroid cartilage to the sternum. To facilitate this, scissors are inserted through the incision and separated, thereby freeing the gland from the overlying structures.

The finger is then swept over both lobes, thereby loosening any small adhesions and either lobe is then elevated. It is frequently possible to raise the gland by traction with a tissue forceps or hemostat, but at times the gland

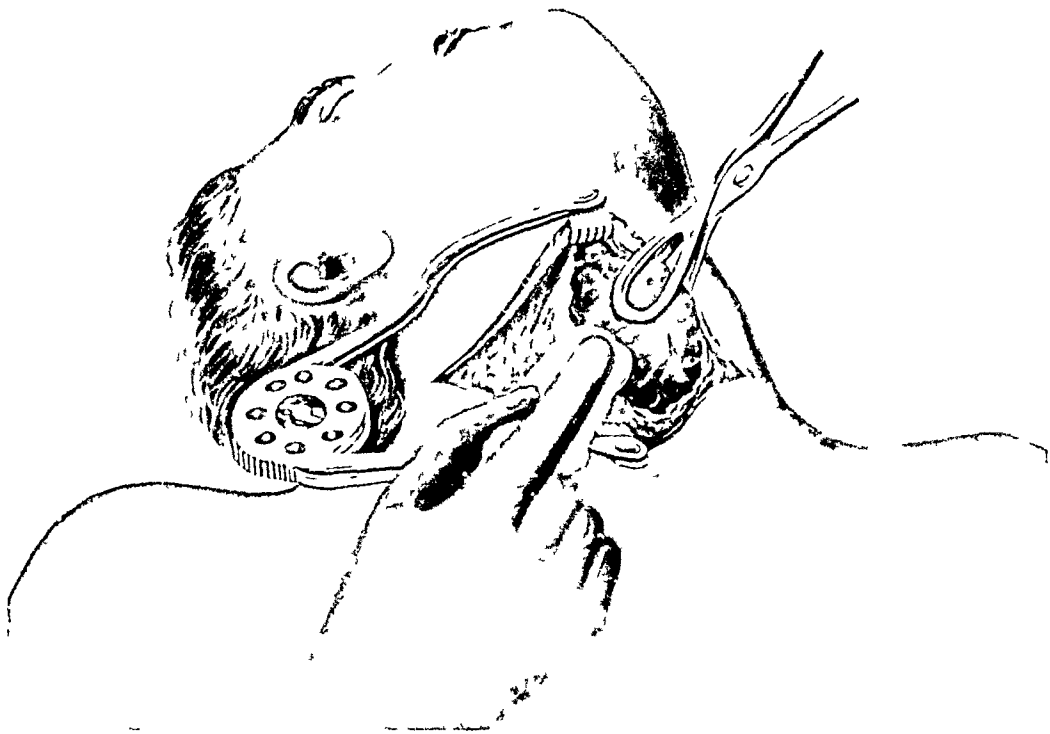


FIG. 2.—Anatomical capsule is wiped from gland with gauze dissection thus carrying important structures away from operative area.

is so friable that this is unwise, and if proper care is used in raising the gland with the finger, no harm will be done.

After the gland is raised it is grasped with a lobe forceps and the anatomical capsule is wiped from the gland with gauze dissection, thereby giving a surgical field with all the important structures removed.

A double strand of catgut is then carried around the upper pole and tied, thus controlling the superior artery. Hemostats are then placed along the side of the gland, inserting them so that they grasp quite a bit of tissue. Three to five are usually sufficient. With sharp dissection the gland is then incised in the proper plane, the idea being to leave gland sufficient to lie on a level with the denuded trachea. If any bleeding points appear while this dissection is being done, they are grasped. After the dissection is carried to the trachea the opposite side is dealt with in similar manner. Slight traction is made while dissecting the second side and as the trachea is reached a line of cleavage usually appears and the isthmus is readily stripped across. Sufficient

# IMPROVED GOITRE TECHNIC

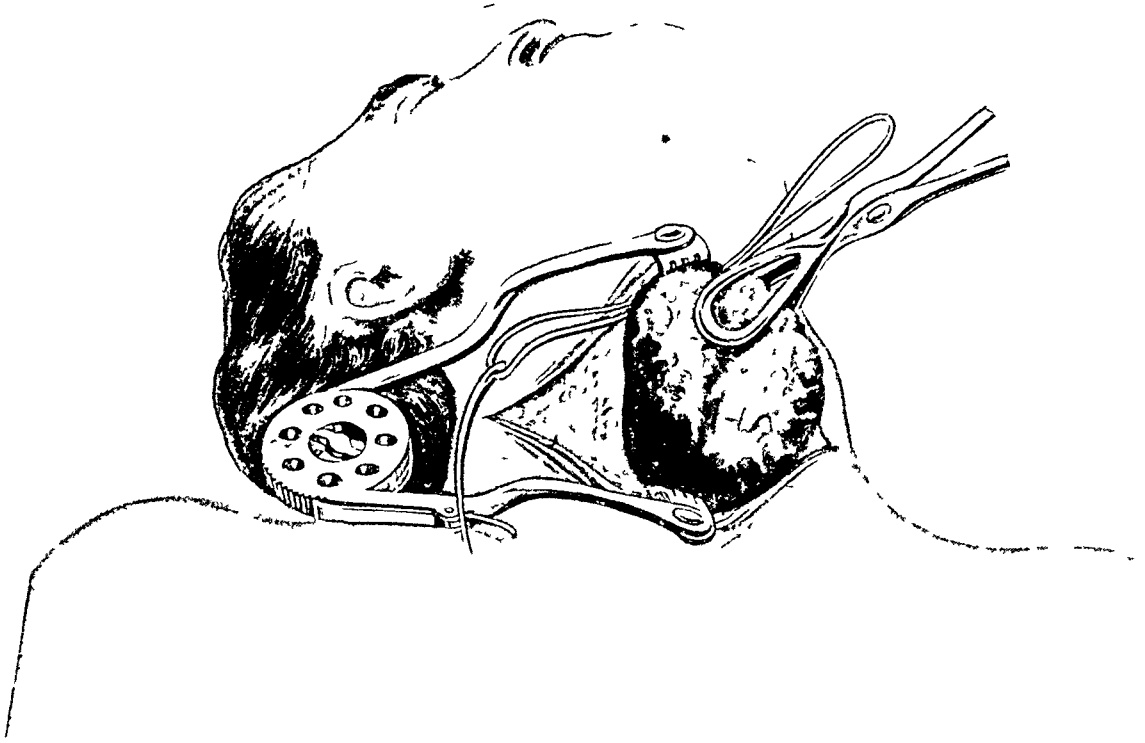


FIG 3 —Double No 3 chromic catgut passed around upper pole and tied

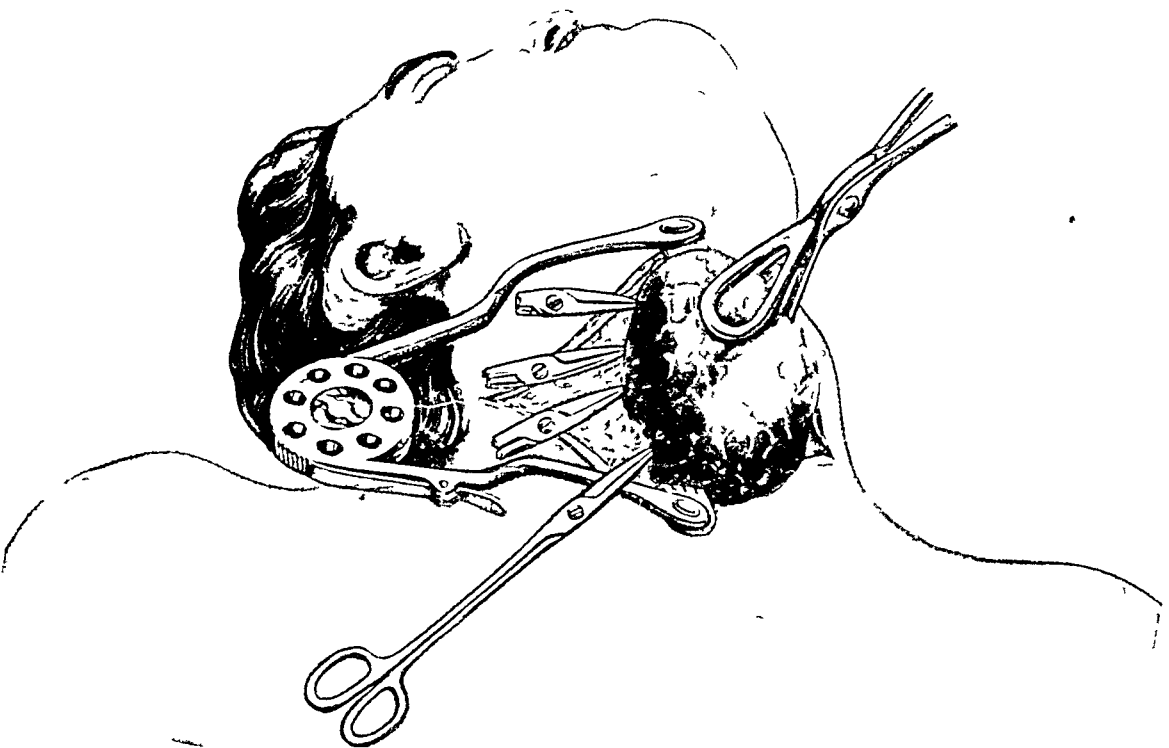


FIG 4 —Placing of clamps on inferior and anastomosing vessels prior to resection

tissue usually remains under this line of cleavage to properly protect the trachea

The hemostats are next tied off, using No. 2 chromic, and the field inspected closely for any oozing

A strip of narrow packing gauze saturated with Albolin (Albolin gauze) is laid over the denuded area and the wound closed. The gauze is brought out the centre of the skin wound and is removed in twenty-four hours. This

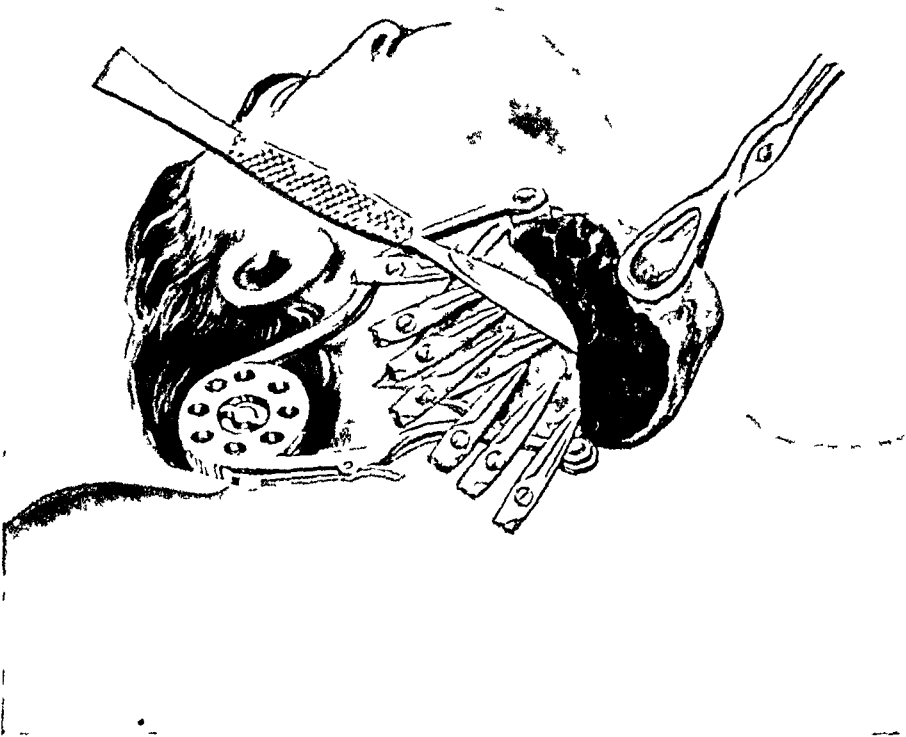


FIG. 5 —Sharp resection of gland—practical in over nine of every ten cases

serves two purposes, controlling oozing which may occur in spite of all precautions, and leaves a small slit through which serum may be removed later. It has been our experience that serum collects in these wounds, even when no drainage has been used and continues to collect for about ten days following operation.

In dealing with encapsulated adenomata, I presented a technic in *ANNALS OF SURGERY* about one year ago (January, 1924), which we still use in all such cases.

Occasionally in exophthalmic cases where the gland is very brittle, it is advisable to cut the sternohyoid and sternothyroid muscles. This may also be true in very large adenomata, but we have found that with a sufficiently long incision separating the muscles, that this procedure is becoming more and more unnecessary.

We still believe that surgery is indicated in toxic colloids, colloids which resist medical treatment, all adenomata, and all exophthalmic cases. Because in our experience

## IMPROVED GOITRE TECHNIC

Toxic colloid goitres are frequently made more toxic by thyroid and iodine therapy

Simple colloid goitres which resist treatment, frequently become toxic under prolonged therapy

Four out of every five adenomata become toxic at some stage

One out of every seventy cases of adenomata will become cancerous

One out of every two hundred cases of adenomata will strangle to death

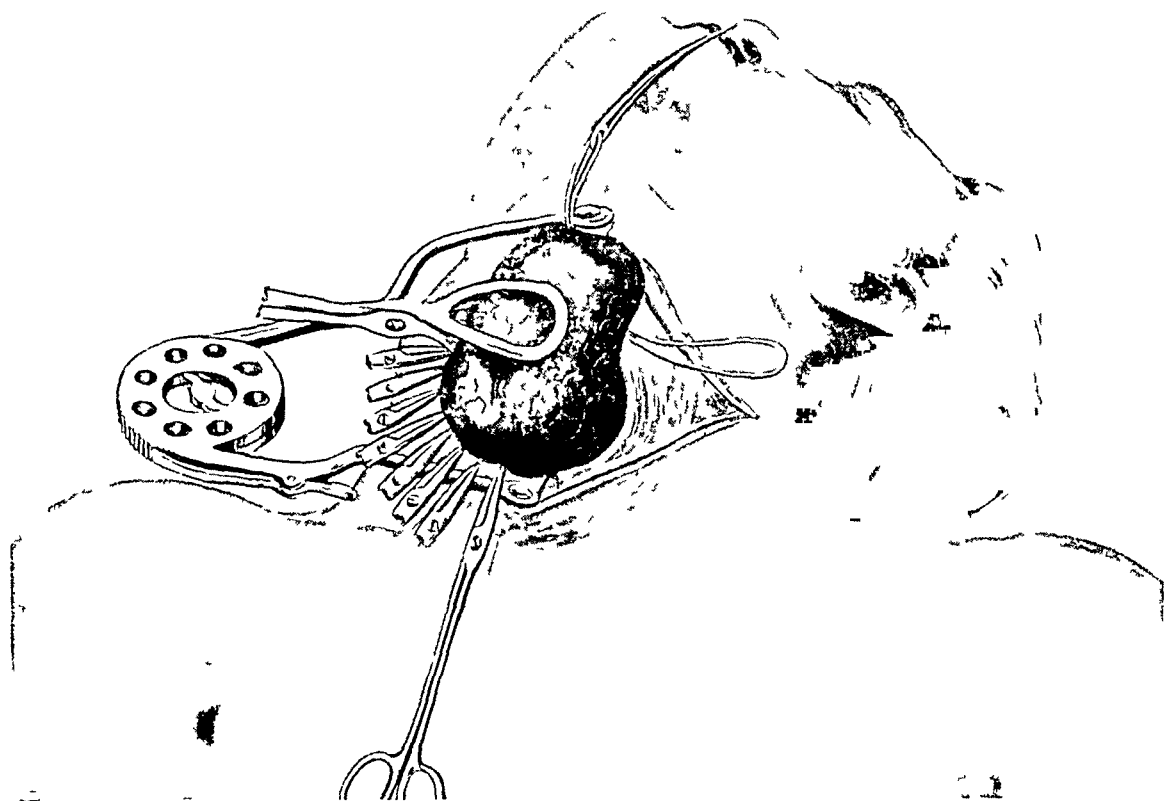


FIG. 6 —Opposite lobe ready for similar resection Whole gland to be removed *in situ*

Myocardial degeneration of the heart will gradually supervene in all toxic cases

Irreparable damage to the heart will supervene in nine out of every ten exophthalmic cases treated medically as transitory cases

Complete thyroid cures are of little value if a permanently damaged heart remains Early operations result in 100 per cent cures in adenomata, 98 per cent cures in toxic colloid removals and 90 per cent cures in exophthalmic cases provided that proper after-treatment is insisted upon Normal function and return to normal working capacity will be much quicker and more permanent following surgery than following medical treatment The mortality in all cases is less than one per cent



# HERNIA OF THE LUNG

By JAMES G. MONTGOMERY, M.D.  
OF KANSAS CITY, MISSOURI

AND

HARRY LUTZ, M.D.  
OF AUGUSTA, KANSAS

A PROTRUSION of any part of one or both lungs through their boundaries, chiefly the thoracic wall, and usually in a sac of parietal pleura under the skin is called a lung hernia. The expression "under the skin" is used to obviate confusion with traumatic evisceration.

The history of lung hernia is difficult to obtain as the literature contains numerous errors and contradictions. The first case was described by Roland in 1499. Later observations were made by Hildanus in 1606, Loyseau in 1617, and Plater in 1641. According to the above definition, the case described by Felix Plater is probably the first true lung hernia and the earlier cases merely traumatic eviscerations.

In an extensive review of the literature we have been able to find fifteen cases reported previous to 1800 and probably only nine of these were true lung hernias.

The following is the Morel-Lavelle classification of lung hernia.

1. According to location
  - a. Diaphragmatic
  - b. Thoracic
  - c. Cervical
2. According to etiology
  - a. Congenital
  - b. Acquired
    1. Traumatic
    2. Consecutive
    3. Spontaneous
    4. Pathological

Strubing, Desfosses, Urbach and others offer two objections to this classification, first, regarding the exact meaning or definition of congenital lung hernia, and second, the use of the word "consecutive" in acquired hernias.

*Diaphragmatic Hernia*—Only one case of diaphragmatic pneumocele is recorded in the literature. Beal's description of this case is that of a right subphrenic abscess. It followed an injury in which the lung herniated through the diaphragm and the intestine was perforated. The lung tissue was pathologically amputated and secondarily infected by the peritonitis from which the patient died. The findings were confirmed by autopsy and microscopic examination of the tissue.

## HERNIA OF THE LUNG

*Congenital Pneumocoele*—Hochsinger says all hernias resulting in the first few weeks after birth must be considered congenital. If we regard Hochsinger's cases as acquired, the congenital lung hernias are only found in foetal monstrosities not compatible with life.

Ciuvellher describes the only case of congenital lung hernia found in the literature. He delivered a foetal monster with an encephalocele over the occiput and an anterior spina bifida in the cervico-dorsal region. The right lung extended up in the neck to the superior border of the larynx.

*Acquired Hernias*—The great majority of acquired lung hernias are traumatic. Those that occur early after injury have been classified by Morel-Lavallee as traumatic, and, late after injury, as consecutive. The word "consecutive" may be omitted from the classification, as it signifies only a difference in the time of appearance of a traumatic hernia after injury.

*Spontaneous Pneumocoeles*—In spontaneous lung hernias there is a rupture through a locus minoris resistentiae due to extreme changes in intra-thoracic pressure. Wightman reports the occurrence of a spontaneous pneumocoele in a flute blower. Boerhaave reports a pneumocoele occurring in a primipara during labor, and Massoti reports a lung hernia occurring in a brewery worker while lifting.

*Pathological Pneumocoeles*—Pathological lung hernias result from diseases of the thoracic boundaries as cancerous abs., empyema necessitatis, perforating lung abscesses, malignant growths, etc.

*Etiology*—In an analysis of 165 cases found in the literature, the figures vary a great deal on account of incomplete data.

*Age*—In 61 cases 21 were under 15 years, 19 were from 15 to 45 years, 21 were over 45 years.

*Sex*—In 58 cases 13 were females, 45 were males. A ratio of over 3 to 1, and this is undoubtedly too low, because at least 50 per cent pneumocoeles are traumatic. In Debienné's cases only 3 out of 41 were females.

*Occurrence*—In 165 cases 29 were congenital or early acquired, 83 were traumatic, 53 were spontaneous. They occur single, multiple, unilateral and bilateral.

*Location*—In 78 cases 10 were in right supraclavicular region, 6 were in left supraclavicular region, 34 were on the right anterior chest wall, 23 were on the left anterior chest wall, 2 were on the right posterior chest wall, 3 were on the left posterior chest wall.

*Anatomical Consideration*—The greatest majority of lung hernias occur on the anterior chest wall, near the sternum. Anatomically there is probably a definite reason why they should occur at this point. Anteriorly, from the costo-cartilaginous junction to the sternum, the external intercostal muscle is absent. Posteriorly, from the costal angle to the vertebra, the internal intercostal muscle is absent. Anteriorly this area is protected by the pectoralis major muscle but it does not afford the restraint supplied the costo-vertebral angle by the heavy longitudinal muscles trapezius, latissimus, dorsi and rhomboidi.

The early workers Morel-Lavallee, Cloquet, Richerand, Bernard,

Hochsinger and others wrote a great deal on the mechanics of the production of a pneumocele

In view of our present-day knowledge of the changes that are possible in intrathoracic pressure as taught us by such physiologists as Donders, Hevinsius, Hutchinson, Herman and Howell together with the added infor-



FIG. 1—Shows the approximate size and location of the lung hernia and scar

mation given us by the U. S. Empyema Commission during the World War on inter- and intra-thoracic pressure relations, we know that lung hernias result from a locus minoris resistentiæ of the thoracic wall and intrathoracic pressure changes. These changes are caused by forcible expiration with varying degrees of closure of the glottis and voluntary contraction or tensing of the muscles of the chest wall, abdomen and diaphragm. According to Sir Arthur Keith in his William Mitchell Banks Memorial Lecture given at the University of Liverpool, November 1, 1923 on "The Origin and Nature of Hernia,"

he states that, "almost all, if not all, hernias in adults are caused by the repetition of strain day by day," and this is applicable to pneumocele Keith, however, does not mention lung hernia

*Etiology of Pneumocele*—Congenital pneumocele follows defects that occur in the ribs and sternum which are covered by fibrous bands and are located chiefly along the sternum They are due to amniotic bands, pressure of the elbow of the foetus against the chest wall, lack of liquor amni, pressure of uterine fibroids, reversal of the foetal head, etc Bronchiectasia foetalis is given as a cause

*Spontaneous* lung hernias are due to Chronic bronchitis, whooping cough, congenital absence of muscles, breasts, etc, absence of intercostal muscles, blowers of glass and musical instruments, tight lacing, straining at stool, lifting and labor, especially in a primipara (Boerhaave), defects in cervical fascia and diastasis of the muscles, especially the scaleni (Graham)

*Traumatic* hernias follow Falls from a height, injuring chest (Roche-Despres), stab wounds injuring the intercostal muscles, fascia or nerves (Lairrey-Velpeau), non-union of fractured ribs (Hugier-Litten), war wounds, shrapnel and bullets (Hertzbeig), crushing wounds (Vogler-Kohler), plastic chest operations of Estlander, Schede and thoracotomy, particularly without an aperiosteal rib resection

*Pathological* pneumoceles follow Breast and lung abscesses (Bruns), empyema necessitatis, caries of ribs, etc, abscess chest wall (Belany)

*Symptoms*—The symptomatology of pneumocele varies a little according to the classification Pain and distress is always present and located in the region of a palpable thoracic rent or orifice, through which a pulsion lung mass projects and reduces spontaneously upon slightly increased expiratory effort

The onset is usually insidious, accompanied by local pain and cough The cough is chronic, spasmodic and non-productive

The congenital types of pneumocele are first recognized by the family or physician The acute traumatic hernias are usually obscured by the more severe symptoms of injury to the viscera, pleura or chest wall

The latent, traumatic hernias, or the consecutive types, are characterized by an insidious onset, pain in the region of the hernia, a pulsion mass, and usually a chronic cough, which ejects the lung at intervals, making the patient twinge with pain as if he had a pleurisy

There are no more systemic symptoms than those which are characterized by inguinal hernia

Local inflammatory conditions, either acute or chronic, may be a sequence of the incarcerated, non-reducible types of pneumocele This is, however, an unusual type

*Physical Findings Inspection*—The physical findings also may vary somewhat with the type of hernia Upon inspection a mass is visible upon the thoracic wall which come through an orifice under the skin and reduces itself spontaneously and synchronously with respiratory effort The size and contours

of the orifice is suggested by the vibratory movement of the skin in this region. The protruding mass is usually ovoid. There may be a local scar, bony irregularity, cutaneous vascular change or signs of inflammation.

*Palpation*—The hernial orifice is usually very easy to palpate, but Wiederhofer's case in which the hernia followed the intercostal vessels, would be an exception. The orifice is either bony or fibromuscular. It is most often possible to insert the tips of one or more fingers into the orifice and by pressure maintain reduction of the mass. When the hernia protrudes, it is possible to grasp the lung and hold its border during respiratory excursion. One can feel the lungs soft, spongy, crepitant consistency.

*Percussion*—The percussion note is tympanic, with probable variation between the tympany of the chest and abdomen (Debienne).

*Auscultation*—Auscultation depends on the pathology present. In the late traumatic type there are few sounds except, when herniation is present. At this time, if the lung is grasped in the sac and held, vesicular whistling and crackling râles are heard.

*Diagnosis*—The diagnosis of pneumocele is perfectly evident because there is usually a history of injury, scar or deformity of the chest wall, a palpable orifice, through which a smooth, soft, crepitant, reducible tumor appears under the skin, and still more conclusive, one may grasp the lung edge while in the sac, feel its consistency and the tug during respiratory excursion.

*Differential Diagnosis*—The differential diagnosis should be made from reducible liquid or gaseous tumors sometimes found protruding through the intercostal spaces in malignancy of the lung, excessive effusions as empyema necessitatis, cold abscess, soft lipomas, angiomas and localized emphysema.

*Prognosis*—Pneumocèles rarely cure themselves spontaneously. Strangulation is not common. (In Wightman's case the pneumocele strangulated followed by pathological amputation with no serious effect.) Lung hernias *per se* rarely cause death. If radical cure cannot be accomplished, it is necessary to modify the patient's occupation and treat the tumor conservatively.

*Treatment*—The treatment is either medical or surgical and depends on the type of hernia, also the existing local and intrathoracic pathology. Fox reports the cure of a case by bandage. Grant reports a recurrence after an apparent cure by bandage. Bandage in Frickhoffer's case caused dyspnoea and cyanosis. Obturators maintained by bandage were made to occlude the hernial orifice. The removal of the underlying pathology will cure certain types as from chronic bronchitis, etc. Where the etiology of pneumocele is occupational, as blowers of glass and wind instruments, heavy lifting, etc. it is necessary to change the type of work. In the conservative treatment elastic bands, plates that cover the hernial orifice, especially made corsets and obturators of various types are used. Most of the early writers spoke disparagingly of any attempt at a radical surgical cure. Vogler, in 1898 suggests

## HERNIA OF THE LUNG

performing a plastic operation, using periosteum or a bone flap from the sternum Vulpus, in 1898, described a plastic operation performed by crossing strips of rib and suturing with silver wire This hernia recurred in a year Graham packed the sac of a cervical pneumocele with iodoform gauze, creating an inflammatory reaction which was followed by cure Tuffier freed and ligated a hernial sac with cure Reymer made an immediate closure of a traumatic pneumocele with cure

To the less than two hundred cases of lung hernia in the literature we

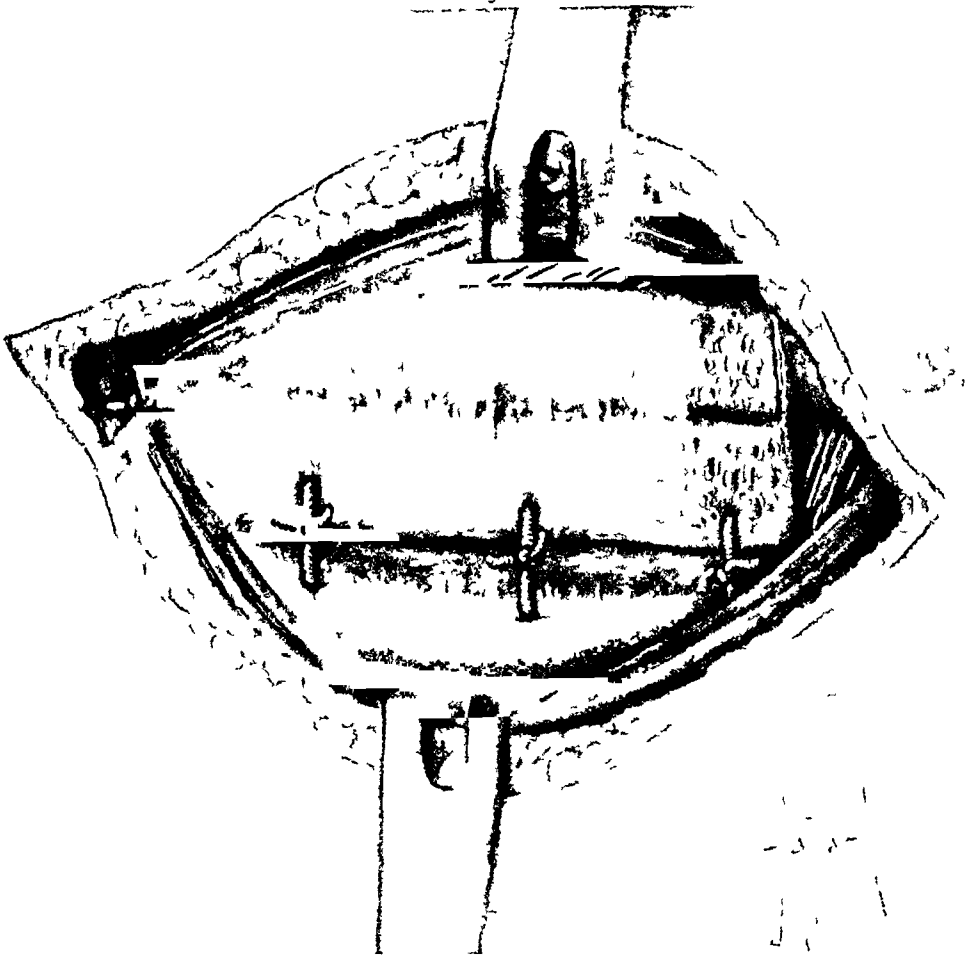


FIG. 2 —Shows the osteo cartilagenous flap obliterating the fourth interspace and hernial orifice

wish to add one case of traumatic pneumocele of the left anterior chest wall cured by an osteoplastic operation

CASE No 4698, male, laundry worker, entered the Kansas City General Hospital, January 16, 1924 His chief complaint was a painful lump in the left precordial region, with a paroxysmal and non-productive cough In February, 1923, he was stabbed in the left anterior chest wall above the base of the heart No medical attention was rendered and recovery seemed complete until December, 1923, when he developed a cough, and simultaneously with the onset of a persistent spasmodic, non-productive cough, he began to have pain in the left mammary region where an intermittent pulsion lump was beginning to form This lump disappears between paroxysms of coughing, during which time he has no pain Examination revealed a fairly well-nourished and developed white male, active, erect, ambulatory five feet six inches tall, weighing 160 pounds, sixty years of age and having the appearance of a man of fifty years His general physical examination is negative

His chest measures 39 inches, is flat anteriorly and full posteriorly due to an upper, senile, dorsal kyphosis. The supraclavicular fossæ are well filled. The respiratory costal excursion is rather limited but equal. On the left anterior chest wall, 2 inches above the nipple and 4 inches from the midsternal line is a scar 1 inch in length and directed transversely. This scar is the result of a stab wound sustained February 15, 1923. The respiratory rate is 21, abdomino-thoracic type, involuntary and normal. Upon deep inspiration a small vibratory depression is perceptible between the fourth and fifth ribs to the left of the sternum. Upon forced expiration, as from coughing, a tumor presents itself through the depressed area.

Palpation reveals a longitudinal opening in the left fourth interspace that is about 2 inches long and  $\frac{1}{2}$  inch wide, extending from the lateral sternal margin to the costo-cartilaginous junction. Inserting the tips of the fingers of one hand in this orifice prevents the protrusion of the spontaneously reducible mass, even during violent coughing. It is also possible during coughing to grasp and hold the tumor and thus prevent it from reducing. It is uniformly round, soft, crepitant tugs with respiratory excursion and measures  $3\frac{1}{2}$  inches in diameter. Percussion over the mass is tympanic. Auscultation over the mass, while holding it in the sac, emits crepitant, vesicular and whistling rales.

Laboratory findings of the blood, urine and Wassermann were negative. X-ray examination by Dr. L. A. Marty showed a little widening of the left anterior fourth interspace and no evidence of pulmonary disease. Dr. L. A. Marty reports a herniation of the lung in the precordial region from fluoroscopic examination.

The diagnosis of pneumocele is made in this case because first, the history of injury, second, a scar and a palpable hernial orifice, and third, the presence of an intermittent, pulsion, cutaneous mass that contains lung tissue, the presence of which is supported by physical and X-ray findings. The location of this hernia lends itself favorably to an osteoplastic procedure. The procedure used here suggested itself by the ease with which intercostal spaces are sometimes obliterated in an aperiosteal resection.

*Operation*—Operation was performed under gas oxygen anesthesia, preceded by morphine, grs  $\frac{1}{4}$ , and atropine sulphate, grs  $\frac{1}{150}$ , given hypodermically one-half hour before the patient was sent to the operating room. A transverse incision, 5 inches long, was made in the left fourth interspace extending from the lateral margin of the sternum to the outer border of the hernial mass. The fibres of the pectoralis major muscle were divided, the thin, friable, tissue paper-like sac of parietal pleura then presenting itself was perforated in manipulation and a partial pneumothorax produced, but not sufficient to embarrass the patient particularly. The intercostal soft parts were so atrophic and the pleural sac so thin and friable that they were entirely disregarded in the repair.

The repair was accomplished by turning the perichondrium and osteum of the anterior surface of the fifth costocartilaginous flap upward into the fourth interspace forming the bed for an osteocartilaginous flap of the fourth rib, which was turned down on the hinge of its periosteum and perichondrium by splitting it in two from above downward with a heavy scalpel. The flap was held in place by four interrupted sutures of No. 2 chromic gut three of which were inserted through the osteocartilaginous flap of the fourth rib into the fifth rib, and one from the sternal end of the rib flap to the sternum. Considerable care was taken to control bleeding. The pectoralis major muscle was closed with No. 3 plain interrupted gut sutures and the skin with an interlocking silk suture. A gauze dressing was applied, covered by a felt pad and held in position by 3-inch adhesive straps going entirely around the chest.

The patient had very little post-operative reaction. He was walking on the second day. The cough stopped immediately. Sixteen days after the operation there was a definite, hard, board-like plaque obturating the original hernial orifice and X-ray demonstrated callus.

In this case we have definitely proven the operability of pneumocele of this type.

and position There is no reason why this method of repair would not be equally successful in other locations

## BIBLIOGRAPHY

- Adams Hernia of the Lung (etc), *Am Med*, 1911, vol 1, p 41
- Adler Ein Fall von einemkinde mit lungenhernie *Berl klin Wehnschr*, 1887 p 119
- Alexandre Enfoncement du thorax, hernie traumatique du poumon, autopsie, *Bull Soc Anat de Par* 1886 vol 111 p 589
- Auler Beitrag zur Kenntniss der Lungenbruche, Berlin, 1892 53 pp
- Bairashevski Pulmonary Hernia, *Voyenno-Med J* 1910 pp 229, 253
- Barbiero-Angelo Ferita del polmone destro, con ernia voluminosa di detto viscere, *Gazz Med di Milano*, 1844-45, vol 111, p 59
- Beale On a Case of Hernia of Lung Through the Diaphragm *Lancet*, 1882 vol 1, p 139
- Behary Hernia of the Left Lung *Indian M Gaz* 1880, vol xv p 221
- Bellamy Memorandum of a Case Hernia of the Lungs, *Lancet*, 1839-40, vol 1 p 824
- Bell Account of a Case in Which a Very Large Portion of the Lungs was Protruded and Strangulated, Occasioned by a Wound in the Thorax Which Was Treated Successfully *Med Comment*, Lond, 1787, Decade 2, vol 1, p 349
- Bell Hernia of Lung, *Edmb Hosp Rep*, 1893, vol 1, p 471
- Bieser Congenital Hernia of the Lung, *Arch Pediat* 1894 vol 11 p 755
- Bickel Ueber traumatische Lungenhernien penetrirende Thoraxwunde, *Deutsche Arch f klin Med* 1903, vol 111, p 550
- Breschet Gas Rare, hernie du poumon, sa cause *Clin d hop*, Par, 1829 vol 11, p 20
- Bruns [Sendschrift an J F Henckel uber Hernia pulmonalis, miserere, U S W], Hanover, 1774
- Buntzen Et Hernia pulmonalis intercostalis, efter al Sandsynlighed spontant *Hosp-Tid Kjobenh*, 1867, vol x, pp 121 125, *ibid J f Kinderkr*, 1868, vol 11, p 305
- Billroth Brustwandungen Missbildungen, Defecte der Brustwand Lungenbruch [etc], *Handbuch der allgemeinen und speciellen Chirurgie*, 1882, III Bd, 2th abth Abschnitt, VI, S, p 114
- Busacchi Presentazione di un malato di ernia polmonare intercostale, *Gazz internaz di med*, 1917, vol 11 p 81
- Cahen Ein Fall von traumatischer Lungenhernie ohne aussere Verletzung, *Munchen med Wehnschr* 1905, vol 111, p 25
- Cairiere Une observation de hernie traumatique du poumon, *Gaz hebdomadaire de Med de Montpel*, 1885, vol 111, p 159
- Cauvy De la pneumocele traumatique *Montpel Med*, 1879 vol 111 pp 225, 318
- Cavaquis Ernua polmonare consecutiva, *Gazz med ital lomb*, 1878, 7 s, vol v, p 481
- Chaussier Observation sur les hernies du poumon *Bull Fac de med de Par* 1814-15, vol 11, p 50
- Chauvin Hernie traumatique secondaire du poumon *Montpel Med*, 1919, vol 111, p 71
- Chavannaz Hernie du poumon *Bull Soc d anat et physiol*, etc de Bordeaux 1893, vol 11, p 161
- Chavannaz Hernie du poumon *Bull Soc d anat et physiol* etc, de Bordeaux, 1893, vol 11, p 161
- Chigayeff [Hernia-like Protrusion of a Lung in a Young Soldier], *Voyenno-Med J*, 1899 vol 111 p 1195
- Chord Supra-clavicular Hernia of the Lung *Lancet* 1889 vol 1 p 1002
- Cloquet Hernie du poumon observee sur un homme age de 45 ans, *N Jour de med, chir pharm etc* 1819 vol 11 p 336
- Cockle Intermittent Cervical Hernia of the Lung, *Med Times and Gaz*, 1873 vol 1 p 5 Double Pulmonary Hernia *ibid* p 31
- Cooper Dictionary of Practical Surgery 2d ed, 1815 p 287 (Quoted by Morel-Lavallee)



- Coulon Pneumocoele congenital a la partie laterale droite du sternum, Bull Soc de chir de Par, 1860-61, 2 s, vol 1 p 121
- Cruveilhier Maladies du poumon Hernies, 1835-1842, Planche III <sup>XXI<sup>e</sup></sup> Liv Tome 2 p 1
- Debiegne De la hernie du poumon Paris, 1897
- Demons Partial Excision of the Lung and Nephrectomy, Recovery, Lancet, 1886, vol 11, p 466 [Tr from Bull et mem Soc de Par, 1886, p 12]
- Desfosses De la hernie du poumon ou pneumocoele, Paris, 1875
- Despres Hernie du poumon, fracture de sept cotes sans plaie, Gaz d Hop, 1889, vol 11, p 733
- Doberer Ein Fall von Lungenhernie and Operation derselben, Wien klin Wchnschr, 1917, vol 111, p 1039
- Dolmatoff [Hernia of Lungs] Vovenno-Med J, 1904 vol 11, p 750
- Drozowski Vulnus punctum penetrans thoracis, hernia traumatica pulmonis, Gaz lek, Warszawa, 1879, vol 111 p 1
- Dubruel Pneumocoele congenital Gaz hebdomadaire de med de Montpel, 1884 vol 11, p 195
- Dufour Observation de hernie traumatique du poumon, guerie sans operation sanglante, Compt rend Soc de biol de Par, 1854-55 2 s, vol 1 pt 2 pp 1-15
- Duplay Hernie traumatique du poumon, Bull et mem Soc de chir de Par, 1878, n s vol 11, p 108
- Durlacher Ein Beitrag zur traumatischen Lungenhernie, Wien klin Rundschau, 1905 vol 11 pp 113, 134
- Durnerin et Vincent Arrêt du developpement portant sur plusieurs cotes, Lyon Med, 1891, vol 117, pp 127-128
- Dutta Wound of Thorax and Hernia of Lung, Indian M Gaz, 1904, vol 111 p 378
- Fabricius Hildanus Observationum et curationum chirurgicarum centuria [etc], p 1611 (Quoted by Morel-Lavallee)
- Farr Intermittent Cervical Hernia of the Lung of Spontaneous Origin, Medicine, 1904, vol 1 p 359
- Favieud Hernie du poumon, Bull Soc anat et physiol, etc, de Bordeaux, 1891, vol 11, p 80
- Fitzwilliams Hernia of the Lung Polychin, 1913 vol 111 p 88
- Fox Cases of Pneumatocele Med Times and Gaz, 1876 vol 11 p 351
- Frickhoffer Die im Herzogthum Nassau inden Jahren 1818 bis 1858 vorgekommenen Bruchneklammungen Bruchoperationem und Kothfisteln in statistischer und Medicinisch-chirurgischer Beziehung Bearbeitet, Repr from Med Jahrb f d Herzogth 1860 p 603
- Friederich Turhandlungen der Physick Medic gesellschaft zu Wunburg 1855, vol 1, p 190
- Froelich Enfant atteint de hernie congenitale du poumon Rev Med de l'est, 1895 vol 11 p 51
- Frontini Intorno ad un caso raro di ernia polmonare in un bambino di tre anni, Rio di clin Pediat, 1904 vol 11, p 192
- Fruhwald Hernie pulmonalis aus blasiger Lungenmissbildung, Jahrb f Kinderh 1885 vol 111 p 418
- Gunk Hernia of the Lung with Report of Case of Spontaneous Hernia of the Right Lung, Internat Clin, J B Lippincott Co, Phila, Pa 1918, vol 11, pp 102-107
- Gailliard Hernie du poumon consecutive a la pleurotomie, guerison, Bull et mem Soc med d hop de Par, 1897, vol 11, p 946
- Gailliard and Baufle Hernie intermittente du poumon gauche consecutive a un ecrasement du thorax, Bull et mem Soc med d hop de Par, 1911, 3 s, vol 111, p 105
- Germer Ein neuer Fall von traumatischer Lungenhernie ohne penetrierende Thoraxverletzung, Munchen med Wchnschr, 1906, vol 111, p 1810

- Goldflam Case of Lung Hernia, Medycyna, Waiszawa, 1904 vol xxii pp 898, 918, 937
- Graham Hernia of Lung and Adenoma of Thyroid, S Clinics N America, 1922, vol 11, p 1493
- Grant Hernia of Lung, Pneumocoele, Report of a Spontaneous Case, Colorado M J, 1896, vol 11, p 379
- Grateloup Observations sur une hernie de la plevre, Jour de med, chir [etc], 1780, vol 111, pp 416-424
- deHaen Praelectiones in Hermann Boerhaavi institutiones pathologicas [etc] 1784, vol 1, pp 113-181
- Hagentorn Cluchai pneumotomiae pri Ivokhochnom naivie [ in lung abscess] Meditsina, S-Petrib, 1892, vol iv, p 53
- Heitzbeig Ueber Hernia thoracica In Verein f pract Med zu Halle d Saale zur funfzigjahrigen Jubelfeier (etc), 1867, pp 9-82
- Hirschprung De medfodte Lungenbrok, Hosp Tid, Kjobenh, 1879, 2 R, vol vi, p 953
- Hofmohl Hernie pulmonaire, Semaine med, Par, 1890, vol x, p 467
- Hochsinger Ueber Lungenhernie und Lungenabszess im ersten Kindersalter, Wien med Wchnschr, 1888, vol xxxiii, pp 1305, 1340, 1378, 1405
- Hugier Quoted by Morel-Lavallce, p 194 (Communique)
- Jiminez Hernias del pulmon, Gaz med de Mexico, 1870, vol v, p 209
- Jorge Hernia del pulmon, neumocoele, Arch Latino-Am de pediat, Buenos Aires, 1922, vol xvi, p 481
- Junquet Observation de pneumocoele traumatique, Montpel med, 1859, vol 11, p 127
- Keith Origin and Nature of Hernia, Brit J Surg, 1924, vol xi, p 455
- Kirchhoff Lungenvorfall, Deutsche med Wchnschr, 1876, vol 11, p 622
- Knox Two Cases of Hernia of the Lungs into the Neck, Lancet, 1885, vol 1, p 515
- Kohler Vorstellung eines Falles von traumatischer Lungenhernie, Berl klin Wchnschr, 1888, vol xxv, p 977
- Lake Hernia of the Lung Caused by the Handle of a Wheelbarrow Penetrating the Side of the Chest, Dublin Q J M Sc, 1852, vol xiii, p 231
- Lattey [Sabre Wound of Lung], Mem de Chir Mil, 1812, vol 111, p 91
- Lehnbecker Operation for Traumatic Hernia of Lung, Zentralbl f Chir Leipz, 1922, vol xlix, p 1408
- Leroux Rapport et reflexions sur cette observation, Hernie du poumon, J Gen de med, chir, et pharm Par, 1809, vol xxxiv, pp 386-394
- Letzner Quoted by Auler, p 15
- Lewtas Congenital Hernia of the Lung, Indian M Gaz, Calcutta, 1876, vol vi, p 212
- Litten Krankenvorstellung, Lungenhernie, Verhandl d Berl med Gesellch, 1891, vol xxi p 77
- Lopez Hernia pulmonu, reseccion y curacion, Siglo Med, Madrid, 1894, vol xli, p 198
- Lovseau Observations Medicinalis et chirurgicales, Bordeaux, vol xxv p 1617
- Loges Ein Fall von posttraumatischer Lungenhernie, Munchen med Wchnschr, 1908, vol lv pt 2 p 2274
- Mace Hernie du poumon chez un premature a paroi thoracique malformee, Bull Soc d'obst de Par 1905, vol viii p 228
- Makins Wounds of the Lungs Chap X p 385 In Surg Exp in South Africa 1899-1900 Blackiston's Son and Co 1901
- Mahlheide Pneumocoele spontane a travers la base de l'appendice xiphoide Gaz Med de Nantes 1883-1884 vol 11, p 87
- Martiny Lungenhernie Pest Med-Chir Presse Budapest 1897 vol xxxiii, p 817
- Masoti Notable caso de pneumocoele espontaneo originado por un estuerzo violento, Rev de med y cirug pract, Madrid 1880 vol vi p 320

- Mauclaire and Faure-Beauheu Hernie susclaviculaire spontanee du poumon gauche, Bull et mem Soc de chir de Par, 1923, vol xlv, p 313
- Mercier Observation de hernie de poumon consecutive a la fracture des 6 me et 7 me vraies cotes du cote droit, J gen de med, chir et pharm, Par, 1809, vol xxxiv, p 378 (Rap de Leroux), pp 386-394
- Meyer De hernia pulmonali, Gryphiæ, 1843
- Mignot Fracture de cote compliquee de hernie du poumon, Soc d sc med de Gannat Compt rend, 1869-70, vol xxiv, p 46
- Miguel De la pneumatocele traumatique, Par, 1892
- Morel-Lavallee Hernies du poumon, Mem Soc de chir de Par, 1845-47, vol 1, pp 75-195
- Nagy Traumatikus tudoserv egy esete [A case of traumatic hernia of the lungs], Orvosi hetil, Budapest, 1896, vol xl, p 29
- Nelaton [Oral communication], quoted by Morel-Lavallee, p 194
- Norris and Landis Diseases of the Chest, etc, W B Saunders Co, 1917 p 517
- Nuñezde Castro Hernia del pulmon, complicada de herida, Cron Med-quir de la Habana, 1886 vol xii, p 514
- Obtulowicz [Rare Case of Rupture], Przegl lek Krakow, 1877, vol xvi, p 197
- Orloff [On Lung Herniæ], Voyenno-Med J, 1899, vol cxcv, p 855
- Pietkiewicz Przypadek przepukliny pluc (pneumocoele) [Case of ], Gaz, lek, 1894, vol xiv, p 1312
- Platerus In consumptione observationes, 1614, Libri, iii, pp 688-698
- Poirier [Discussion of Raynier's case], Bull et mem d l Soc de chir de Paris, 1895 N S 21, pp 646-649
- Polya Kongenitaler Defekt der Brustmuskeln mit Lungenhernie, Pest med-chir, 1909, vol xlv, p 149
- Rasner [Some Remarks about the Lungs in their Clinical Aspect], Przegląd lekarski, Krakow, 1881 vol xx, p 433, 451, 462
- Rayer Quoted by Morel-Lavallee, p 194
- Reynier Hernie du poumon a travers l'eclatement complet d'un espace intercostal, emphyseme generalise, intervention guerison, Bull et mem Soc de chir de Par 1895, vol xxi, p 646
- Reibold Ein fall von traumatischer Lungenhernie ohne aussere Verletzung, Munchen med Wchnschr, 1904 vol li, p 433
- Rhodus Observ medicinalium centuriæ tres Padone, 1857 (Quoted by Morel-Lavallee)
- Richerand de l'Empyeme (Nosographie et Therapeutique chirurgicales, 5th ed, 1821, Tome 3, pp 300-301
- Richter Chirurgische Bibliothek, Dr Bruns Beobachtungen von einem Lungenbruche, 1774, vol iii p 138
- Rivers Sopra un caso di ernia polmonare riscontrato inunsoldato dell' 85° regimento fanteria, Gior med d r esercito, etc, 1890, vol xxxviii, p 1020
- Roche Hernie traumatique du poumon, Bull Soc med de l'Yonne, 1882, vol xxii, p 107
- Rocher Hernie congenitale du poumon droit, Gaz hebdomadaire de Bordeaux, 1922, vol xliii, p 291
- Rolandus De Volmonis sanaripot, Liber iii (Cap), vol xxv, p 144 In Guy de Chauliac, Cyrugia, p 1499
- Rothenpieler Ein casuistischer Beitrag zur Behandlung der Lungenhernie, Wien med Bl, 1898, vol xxi, p 471
- Roussel Hernie spontanee du poumon, Arch de med et pharm mil, Par, 1895, vol xxvi, p 61
- Royero Neumocoele, An r Acad de cien med de la Habana, 1873-4, vol x, p 66
- Ruysch Obs anat, chir, carum anturo, Amstelodami, 1691 (Quoted by Morel-Lavallee and Auler)

## HERNIA OF THE LUNG

- Sahl: Vorstellung eines Mannes mit ausserer Lungenhernie nach Estlander'scher Operation 47 versammlung des ärztlichen Centralvereins Cor-B1 f Schweiz Aertzte, 1894, vol xxiv, p 474
- Sabatier: Quelquesfois, un hernie du poumon In *Medicine Operatoire*, etc, 1796, T, vol II, p 245
- Sabrazes: Arrêts de développement des parois thoraciques avec pointe de hernie du poumon, *Rev de med*, Par, 1894
- Scholz: Heilung einer penetrirenden Brustwunde bei Vorfall eines lungentheiles, *Wien med Presse*, 1878-1913
- Schramm: Ueber Lungenhernie, Berlin, Jackel, 1918
- Singh: Wound on the Chest, Protrusion of Lung, Death, *Indian M Gaz*, 1877, vol xii, p 245
- Storch: Malias Pelargi Theoretischen und Praktischen Abhandlung von Kinderkrankheiten, etc, 1750, vol iv p 48
- Strubing: Ueber spontane Lungenhernien der Erivachsenen, *Arch f path anat*, etc, Berl, 1889, vol cxvi, p 205
- Temple: Traumatic Hernie of the Lung, *Virginia M Month*, 1882-1883, vol ix, p 83
- Tillmans: Text-book of Surgery—translated by Tilton from 7th German Edition, vol II, p 660, D Appleton and Co, 1901
- Trelat: Hernie congenitale du poumon, *Gaz d hop*, Par, 1880, vol lIII, p 1060
- Tuffier: De la resection du sommet du poumon, *Semaine med*, 1891, vol xi, pp 202, 203
- Tulpius: Pulmonprecissus, Cap XVIII, *Observationes Medicæ*, 1672, p 124
- Urbach: Ueber Lungenhernien, *Deutsche ztsch f chir*, Leipz, 1909, pp 102, 103
- Van Haelst: Vercauteren Observation d'un cas de hernie pulmonaire, *Belgique Med*, Gand-Haarlem, 1903, vol x, p 179
- Van Reeth: Hernie pulmonaire stranglee, *Arch med Belges*, Par, 1917, vol lxx, p 1142
- Verdeau: A propos d'un cas de hernie traumatique du poumon, *Caducée*, Par, 1914, vol xiv, p 33
- Vogler: Beitrag zur Kenntniss der traumatischen Lungenhernien, *Monatschr f Unfallheilk*, Leipz, 1898, vol v, p 169
- Vulpus: Ein Versuch zur Heilung der Lungenhernie, *Berl klin Wchnschr*, 1900, vol xxxvii, p 1152
- Wahl: Zur casuistik der Schusscontusionen, *Arch f klin Chir*, Berl, 1872, vol xiv, p 34
- Weiss: Traumatische Lungenhernie, *Arch f klin Chir*, 1877, vol xxi, p 244
- Widerhofer: Hernia pulmonalis aus blasiger Lungenmissbildung, *Jahrb f Kinderh*, 1885 N F, vol xxiii, p 418
- Wightman: Report of a Case of Hernia of the Lung, *Brit M J*, 1898, vol I, p 365
- Wolfler: Linksseitige sincipitale Pneumatocoele, *Mitth d Ver d Aertze in Steiermark*, 1890, Graz, 1891, vol xxvii, p 19

# SOME CONSIDERATIONS PERTAINING TO THE DIAGNOSIS AND SURGICAL TREATMENT OF DISEASES OF THE GALL-BLADDER

BY FRANK E. BUNTS, M.D.  
OF CLEVELAND, OHIO

GALL-BLADDER diseases present a series of problems both in regard to their diagnosis and to the indicated mode of treatment, final judgment regarding the solution of which is still *sub judice*

As for the diagnosis, perhaps in the case of no other organ is it so difficult to identify the seat of the pathological condition from the presented symptoms. It is true that repeatedly in the literature we find the classical symptoms of gall-stones described and yet repeatedly we encounter patients who present these so-called classical symptoms but in whom operation has demonstrated that they were due to acute appendicitis, to a kidney stone, to Dietl's crises, to a perforated gastric ulcer. And if the diagnosis is to some degree uncertain in the "classical" cases, to a far greater degree is the nature of the condition masked in cases which present only general, vague symptoms which may be due to almost any visceral disorder.

And when we turn from diagnosis to treatment, we find fundamental differences of opinion between the internists and the surgeons as to which cases should be submitted to medical treatment and which to operation, and among the surgeons themselves there are differences of opinion regarding the preferred surgical procedure in certain types of cases.

It is my purpose in this paper, therefore, in place of a formal presentation of any phase of the manifold problems presented by gall-bladder disease, to discuss only certain points pertaining to the diagnosis and treatment of gall-bladder disease as they have been emphasized in the experiences of my associates and myself in 1405 cases and as they have been suggested by the questions which have been asked at various medical meetings before which I have been privileged to discuss this general problem.

It is of interest to note that the problems presented by gall-bladder disease are not new problems. Many of those with which we are most concerned to-day have been recognized since the first operations for gall-bladder stones were performed in the United States—by John Stough Bobbs, in 1868, Marion Simms in 1878, and by Lawson Tait, in England in 1879, and even in the later literature which has appeared since that time we find attempts to answer such still familiar questions as the following:

Is the gall-bladder a comparatively functionless organ?

Is infection the prime cause of gall-stone formation?

How can cholecystitis and cholelithiasis be differentiated from gastric diseases, appendicitis or kidney lesions?

Is cholecystectomy or cholecystotomy the operation of choice?

What is the most favorable time for operation?

## SURGICAL TREATMENT OF DISEASES OF GALL-BLADDER

What is the source and location of new stones which form after cholecystectomy?

Where do stones form primarily?

Many of these same questions I find among questions asked at recent medical meetings

It would take too long to discuss in detail the differential diagnosis of gall-bladder diseases. I will merely note that the conditions which should be borne in mind in establishing a differential diagnosis in a case in which a gall-bladder lesion is suspected, include such conditions within the genito-urinary tract as renal stones, Dietl's crisis and pyelitis, diaphragmatic pleurisy, acute pancreatitis, acute appendicitis, gastric perforation, a list to which, in a recent paper, Doctor Phillips adds angina pectoris, abdominal angina associated with abdominal arteriosclerosis, pericarditis, epigastric hernia, lead colic, herpes zoster and the gastric crises of tabes. In many of these conditions, the clinical history and an analysis of the symptomatology provide a sufficient clue once the possibility that some one of these various conditions may be responsible is borne in mind.

As for the differentiation from kidney stones and from gastric ulcer in particular, the rôle of the roentgenologist is of prime importance, for it has been our experience that our percentage of correct pre-operative diagnoses increases in direct relation to the amount of study which our roentgenologist devotes to these patients. A number of plates in different positions including one of the genito-urinary tract, in many cases present definite evidence of gall-bladder disease to the trained eye of the roentgenologist. This judgment is by no means always based upon the definite presence of shadows of stones. Thus in some instances plates of the stomach will show deformities of the duodenal cap which are due to direct pressure from an enlarged gall-bladder or to adhesions from the gall-bladder or to reflex spasms of the duodenum initiated by an abnormal gall-bladder. Such pressure deformities and adhesions are not confined to the duodenal cap but in some instances affect the pyloric end of the stomach. Adhesions from the gall-bladder may produce a distortion of the duodenal outline or the duodenum may be displaced by a distended gall-bladder.

A study of the colon may determine the presence of adhesions of the colon to the gall-bladder. Such studies as these demand first the taking of a number of plates of different densities followed by a careful study of the pyloric end of the stomach and of the colon continuously after the ingestion of a barium meal.

Whether suspicious shadows on the upper right side pertain to the kidney or gall-bladder may be determined by comparing the size of the shadow on plates taken in an anterior-posterior position with that on plates taken posterior-anteriorly. The gall-bladder shadows are usually close to the abdominal wall and considerably smaller when the patient is in the prone than when he is in the supine position. Insertion of opaque catheters in the ureters with pyelograms of the kidney and stereoscopic plates will aid in the

localization of these shadows. In many cases the outline of the gall-bladder is visible as the result of a thickened wall and its pathological contents, although it should be borne in mind that the fact that the gall-bladder may be visualized on an X-ray plate does not necessarily mean that it is pathological.

Whether or not spasm of the pyloric cap is due to a reflex stimulus from a pathological gall-bladder may be determined by giving the patient atropin in sufficient dosage to produce relaxation. In such a case the deformity will be persistent if it is due to a duodenal ulcer. In our experience plates of the gall-bladder will determine definite gall-stone shadows in over half of the cases operated upon, this has been determined by a rigid comparison of all gall-bladder plates taken at the Cleveland Clinic during the past two years with the operative findings.

We believe that in the great majority of cases, X-ray findings, together with the clinical history and the physical examination, will enable us to establish the diagnosis not only of cholelithiasis, but also of cholecystitis. Striking examples of cases in which the X-ray findings plus the history determine the diagnosis are those cases of prolonged and intractable indigestion with so-called gastric crises in which it may appear very definitely that the symptoms are not due to ulcer or tumor or other intrinsic cause. In these cases the X-ray will often reveal the presence of gall-stones. I wish, however, to lay particular stress upon the point that while all the diagnostic methods which are at our command should be utilized, final diagnosis must rest upon their interpretation by clinical judgment based upon extending clinical experience.

As for the treatment, there would seem to be no difference of opinion between the surgeons and the internists regarding the indication for operation in such conditions as acute suppurative cholecystitis, persistent recurring gall-stone colic, perforation of the gall-bladder, obstruction of the common duct from stone, chronic distention of the gall-bladder. The differences of opinion are found in the consideration of cases of gall-stone colic in which the pain is not very severe and the recurrences are perhaps at long intervals, of cases of acute catarrhal cholecystitis, of cases of persistent dyspepsia which present signs of gall-bladder disease. And among the surgeons themselves the principal differences of opinion are expressed in the old controversy between the relative merits of cholecystectomy and cholecystotomy.

In 1902 Roswell Park made the query, "Why should we not treat the gall-bladder as we do the appendix," and he concludes

"Whether, then, the case be acute and fulminating or chronic and growling, I would say that the diseased and troublesome gall-bladder like the diseased and troublesome appendix should come out and that we should now formally include a cholecystectomy as the ideal operation corresponding to appendicectomy. My past year's experience with a relatively large number of these cases has taught me that one is no more dangerous than the other and is equally satisfactory. I now scarcely think of leaving an evidently diseased gall-bladder after exposing it any more than I would think of partial operation upon the appendix."

## SURGICAL TREATMENT OF DISEASES OF GALL-BLADDER

As I have stated above, throughout all these years the battle has raged between the proponents of cholecystectomy as opposed to cholecystotomy, the ultimate basis of the dispute apparently resting upon final decision as to whether or not the gall-bladder is or is not an essential functioning organ. In our own experience we believe that in too many cases, the gall-bladder which has only been drained continues to give trouble so that its later removal is necessitated. It is our practice, therefore, to remove it under the following conditions. After there has been an acute attack of cholecystitis, in the presence of a stone in the cystic duct or evidence of the former presence of the stone, if the gall-bladder walls are thickened. If the gall-bladder presents a normal appearance and the patient presents no history of a previous acute cholecystitis, the gall-bladder is left. There are those still, who, like Park, advocate the removal of the gall-bladder under all conditions just as the appendix is routinely removed on the basis that since good health is possible without it, it is a mistake to leave it as the possible seat of later trouble. As Judd has shown, however, in the absence of the gall-bladder, the common duct to some extent acts in its place for the storage and concentration of bile and, therefore, shows a tendency to become dilated, and as a storage viscus there will exist within it the same tendency for stone formation as formerly existed in the gall-bladder. For that reason, as Crile has stated, "it would seem far better to take a remote chance of future recurrence of trouble in the gall-bladder than a considerable chance of the occurrence of common duct stones."

Figures from the literature might be cited to show the general basis for considering cholecystectomy to be in general the preferred procedure. The statistics of the Mayo Clinic, as recently reported by Judd in an extensive study of the mortality following operations on the liver, pancreas and biliary passages, give emphatic evidence in support of their contention that cholecystectomy is in general the operation of choice.

In our own series of operations on the gall-bladder performed since 1919, which includes 400 cholecystectomies and 129 cholecystotomies, the operative mortality in the former series—cholecystectomies—was 1.7 per cent, while in the latter—cholecystotomies, it was 6.9 per cent. In a follow-up study of our total series—those before as well as those since 1919, we have heard from 524 patients 271 of whom had had cholecystectomy and 253 of whom had had cholecystotomy. Among these, 8 per cent of the patients who had had cholecystotomy reported that they had had a subsequent operation on the gall-bladder, while only 1.9 per cent of the patients in whom cholecystectomy was performed had had a subsequent operation for the removal of stones.

Our reason for the division of our statistics into these two periods—before and after 1919, has been the change in our own opinion as to the relative merits of these procedures, which is shown by the fact that prior to 1919 in a total of 876 operations, 255—29 per cent were cholecystectomies and 621—71 per cent were cholecystotomies, while since 1919 among 529 operations 400—75.6 per cent have been cholecystectomies and



only 129—24.4 per cent have been cholecystotomies. These figures show an exact reversal of our former judgment.

It may be well to add a word regarding the treatment of acute cholecystitis when the patient is in a desperate condition. In such cases we believe that the primary procedure should be a cholecystotomy for the establishment of drainage only, the removal of the gall-bladder being deferred until the condition of the patient warrants the major operation. It should always be borne in mind that the safety of the patient is our prime consideration, the condition of the individual case, therefore, is the final criterion, in accordance with which the choice of operative procedure must be made.

A word may be added at this point regarding the treatment of jaundiced cases. In these cases, as has been emphasized by Judd and his associates at the Mayo Clinic, in particular, the prime danger is hemorrhage due to the lengthening of the clotting time of the blood. If operation is delayed until therapeutic measures have brought the clotting time within safe limits, the danger of operation in these patients is by so much diminished. In the Cleveland Clinic Hospital as a routine measure with jaundiced cases, we begin at once the administration of 10 grains of calcium lactate by mouth every four hours. If the clotting time is more than five minutes, 10 c.c. of a 5 per cent solution of calcium chloride is given intravenously once a day for three successive days in addition to the calcium lactate. A high caloric, low protein diet is given at frequent intervals—every two hours—during the day and preparation is made for two transfusions to be given, one before and one after operation, or both after operation, according to indications. If there is complete absence of bile in the stools, from 60 to 90 grains of desiccated ox bile is given daily. I may add that in our judgment, no patient should be operated upon during an acute attack whether jaundice is present or not, unless the symptoms indicate the presence of empyema in the gall-bladder.

In those cases in which drainage only is indicated as a primary and perhaps as the only surgical procedure, the importance of sufficiently prolonged drainage should be emphasized. The drainage should be continued until the bile is bacteria free. Disappearance of the bacteria may be hastened by frequent irrigation of the gall-bladder through the drainage tube.

The question as to whether or not the appendix should be removed as a routine procedure is not definitely settled, although it is the practice, I believe, of the majority of surgeons. In my own judgment the appendix should be examined and removed if there are any signs of abnormality. Unless the cæcum is sufficiently mobile for the appendix to be readily brought into the incision for the gall-bladder operation, the usual McBurney incision should be made rather than an extension of the gall-bladder incision, thus on the one hand avoiding any undue tugging upon the attachments of the cæcum, and on the other, avoiding division of the nerves supplying the rectus muscle and diminishing the possibility of a ventral hernia.

Among the possible unfortunate occurrences which may be incident to a

## SURGICAL TREATMENT OF DISEASES OF GALL-BLADDER

gall-bladder operation are interference with the circulation of the splanchnic veins, hemorrhage, free bile in the peritoneal cavity. The principal cause of the first of these is heavy packing with gauze bearing down upon the surface of the liver—a cause which suggests its own remedy. The control of hemorrhage is peculiarly essential in these operations. It is for this reason that the precautions described above in the case of jaundiced patients are especially important. Bile in contact with free peritoneal surfaces has a destructive effect which is often unappreciated, and when it is absorbed into the system, of course, the general effects of jaundice will be produced. It is for these reasons that the protection of the peritoneal cavity against any bile leakage is especially important. It is therefore imperative that if cholecystectomy is to be performed the gall-bladder should not be open, and that if cholecystotomy is to be performed, leakage-proof drainage should be established.

The treatment which should follow cholecystectomy depends to a large extent upon the clinical course of the individual case. In general, a cholesterol-free diet is indicated and milk of magnesia is of value as a laxative and antacid. A carefully planned hygienic regimen should be prescribed and the patient should be urged to report to his family physician or to the surgeon at sufficiently frequent intervals for the early recognition of any untoward sequel.

The occurrence of pain shortly after operation—pain which may simulate that of gall-stone colic, may be due to the presence of stones in the hepatic ducts which were not discovered at the time of operation or may be due to the presence of mucus. In such cases the patient should be placed under medical treatment which in general consists in a carefully restricted diet consisting principally of cereal, milk and fruit juices and the application of hot packs over the gall-bladder region, control of pain when necessary by codein or even morphin, gradual increase in the diet as the pain subsides. That is, the treatment should be that which is generally indicated in cases of acute cholecystitis.

It may be well to add a note regarding various apparently unrelated conditions which are sometimes relieved by operation upon the gall-bladder, although it is difficult to understand exactly how this relief is produced. Two such conditions may be mentioned in particular—functional diabetes and asthma. The occurrence of backache is more easily understood when one considers the nerve centres which are closely associated with the gall-bladder and the liver.

This latter associated condition is well illustrated by a recent case in which there was intense pain which extended around the chest and base of neck. The patient felt as if she were held in a vise. She felt worse when lying down and could not lie at all except on the left side. As her skull had been fractured ten weeks before in an automobile accident, it appeared as if this pain must have been associated with that injury. On account of the fact that there was some deformity of the spine the patient was referred to the orthopaedic department. An X-ray of the spine, however, while it revealed an arthritis did not show any evidence of a fracture and therefore a gastrointestinal examination was made to determine if possible the underlying cause of the

arthritis In the latter examination definite gall-stone shadows appeared on the X-ray film Cholecystectomy was performed, and several black faceted stones were found in the gall-bladder which on pathological examination gave evidence of chronic productive cholecystitis The patient made an excellent recovery not only from the operation, but also from the severe backache

This case has been cited in detail not only as an illustration of the fact that backache may be due to a pathological condition in the gall-bladder, but also to emphasize the fact that the gall-bladder may be the site of an infection which is the primary cause of apparently unrelated conditions When a focus of infection is being sought, therefore, the gall-bladder should not be overlooked, especially when other possible foci, such as the teeth, sinuses, tonsils or appendix have failed to be incriminated

Additional data of interest which has been secured from a study of our cases are that 71 per cent were in women, and that the highest incidence was between the ages of 30 and 40, 29 per cent were between the ages of 30 and 40, and 75 per cent between the ages of 30 and 60 That is, gall-bladder disease does not appear to be a disease of either youth or of old age

Whatever may be the point of view of individual surgeons regarding the problems which I have mentioned above, the sum of the whole matter has been expressed in a recent paper by my associate, Doctor Phillips, who, after having discussed certain causes of the failure of gall-bladder operations to cure the patient, and assuming for the internist as well as for the surgeon the responsibility of preventing these failures, says "On the surgeon rests the responsibility for improving the technic of his operations that he may secure better results After operation he should refer these patients back to the internist so that they can be kept on a proper dietary and hygienic regimen instead of saying to the patient as is so often done, 'the cause of your trouble has been removed you can eat anything you wish'"

If this responsibility is fully assumed it will mean that we shall not adopt any hard and fast rule for the treatment of any case, but the consideration of each case will be strictly individualized and the surgeon's best clinical judgment plus the aid of all available methods of diagnosis will be used as a guide to the therapeutic measure to be applied

# WANDERING SPLEEN WITH TORSION OF ITS PEDICLE

By JOHN E. SUTTON, JR., M.D.

OF NEW YORK, N.Y.

FROM THE SECOND SURGICAL (CORNFELL) DIVISION, BELLEVUE HOSPITAL, SERVICE OF DR. H. F. SANTFEL

AXIAL rotation of the spleen upon its pedicle is recorded in the literature in the cases of about seventy women and in three males. This condition was first reported in a man by Petridis in 1918. During the next year Pieri performed a splenectomy on an Italian soldier for this disease, and Southam, in 1921, submitted the report of a case in an English boy of six years. After a careful search of the literature no cases have been found occurring in the male in the United States.

On December 17, 1924, a boy aged thirteen years, was admitted to the Bellevue Hospital complaining of severe generalized abdominal pain of twenty-four hours' duration. Early in the morning of the previous day he was awakened from a sound sleep by intense cramp-like pain in the epigastrium. He vomited several times but the pain continued. During the morning a good bowel movement gave slight relief for a short time. Several hours before coming to the hospital his pain became more intense in the right lower abdominal quadrant. He was seen by his family physician, who sent him to us with the diagnosis of "probable acute appendicitis."

On the day prior to the onset of his abdominal pain the patient had a chill and an intensely sore throat developed. Up to the time of this illness he had attended school regularly, had done no violent exercise, and had not fallen or injured his abdomen. There was no history of previous abdominal pain, indigestion or constipation. His genito-urinary history was negative.

Physical examination showed a normally developed and nourished boy with a flushed face who appeared to be acutely ill, lying quietly in bed, but with his thighs flexed on the abdomen. His temperature was 102.8° F., pulse 120 and respirations 24. There were no abnormalities of the eyes, ears or nose. The tongue was slightly coated. Both tonsils were markedly swollen and red with many of the crypts filled with purulent exudate. The neck was normal. His lungs were clear. The heart was normal in size, but the sounds at the apex were of a slapping character, and in this area there was a soft blowing systolic murmur which was transmitted neither to the axilla nor to the base. The abdomen was flat, symmetrical and held rigidly throughout its entire extent. On palpation there was acute tenderness in the region of the cæcum and sudden release of pressure produced acute pain. Pressure over the splenic flexure of the colon did not produce pain at McBurney's point when the patient coughed. Across the entire lower abdomen the muscles were held very tensely and what appeared to be board-like rigidity was present. No masses were recognized by abdominal palpation. A rectal examination unfortunately was not made.

His blood showed 28,000 white cells per cubic millimetre with 90 per cent polymorphonuclear leucocytes and 10 per cent lymphocytes. A urine examination showed no abnormalities. A provisional diagnosis of acute peritonitis secondary to acute appendicitis was made and the patient was prepared for an immediate operation.

Under nitrous oxide-oxygen and ether anæsthesia a five-inch lower right rectus incision was made and the muscle retracted laterally. On incising the peritoneum there was a gush of thin cloudy fluid. The coils of small intestine were moderately dilated, but the serosa was glistening and not inflamed. The appendix was normal. The

ascending, transverse and sigmoid colons were dilated to about twice their normal size. Occupying and completely filling the pelvis was a mass which was recognized to be the spleen. It was enlarged to more than three times its normal size. The surface was smooth, glistening, free from fibrin or adhesions, and its color was bluish-black. The pedicle, on which it had rotated 360 degrees, was ten inches long and looked like a large umbilical cord. No pulsations could be felt at the hilus of the spleen. In the region of the tail of the pancreas the pedicle was a soft cord in which pulsations could be felt. Distal to the site of torsion, which was at about its midpoint, the pedicle was very swollen and oedematous. The spleen was easily delivered from the pelvis and after enlarging the incision it was removed from the peritoneal cavity. The pedicle was triply clamped close to its base and divided between the two distal clamps. The stump was then transfixed and ligated with number 2 plain catgut which was reinforced by a ligature of number 2 chromic gut. After removing as much fluid as possible by suction, the abdomen was closed in layers without drainage. Cultures from the peritoneal fluid and from the cut surface of the spleen showed staphylococcus aureus and a gram-negative bacillus. Microscopic examination of the spleen showed intense congestion but no other abnormalities.

The convalescence was uneventful. Under hot saline throat irrigations the tonsillitis promptly subsided. The evening temperature on the first post-operative day was 101° F and after the third day the temperature curve was flat. The wound healed by primary union. On the fourteenth post-operative day the patient was sitting in a chair and three days later he was discharged from the hospital.

A complete blood count three hours after the operation showed red blood cells 5,020,000, haemoglobin 88 per cent (Dare), white cells 31,700 with 88 per cent polymorphonuclear leucocytes, 7 per cent lymphocytes and 3 per cent transitional cells. On the fourth post-operative day the haemoglobin had fallen to 78 per cent (Dare) and the red blood cells numbered 3,920,000. The white blood cells had decreased to 16,000, with 78 per cent polymorphonuclear cells, 18 per cent lymphocytes, 3 per cent large mononuclear cells and 1 per cent eosinophiles. On the ninth post-operative day the haemoglobin had increased to 94 per cent (Dare) and the red cells were 4,960,000. The white cell count showed 17,200 cells with 77 per cent polymorphonuclear cells and 22 per cent lymphocytes.

Six weeks after discharge from the hospital (February 15, 1925) the patient was reexamined. He said that he had returned to school and was feeling perfectly well. He had had no indigestion, constipation, pains or aches in any of his bones or joints. His appetite was excellent and he thought that he had gained some weight. He and his family had noticed that the color of his face and lips had markedly improved. There had been slight discomfort in the region of his abdominal scar on changes of weather. He presented the picture of robust health. His cheeks and mucous membranes were of a healthy red color. There was a slight keloid formation in the scar but there was no weakness of the scar or the adjoining muscles. A complete blood count at that time showed a haemoglobin of 100 per cent (Dare) and a total red cell count of 5,100,000. The white cells numbered 14,800 with 59 per cent polymorphonuclear cells, 40 per cent lymphocytes, 0.6 per cent eosinophiles and 0.3 per cent basophiles. All of the red cells stained uniformly, were of normal size and contour and there were no abnormal forms seen.

On March 15, 1925, a second follow-up examination showed the same physical condition and the boy had no complaints. His haemoglobin had reached 105 per cent (Dare) and the total number of red cells was 5,100,000. The white cells numbered 10,200 and the differential count showed 50 per cent polymorphonuclear cells, 42 per cent lymphocytes, 5 per cent transitional cells and 3 per cent eosinophiles.

In reviewing this case it is interesting to note the sudden acute onset and the course which simulated acute appendicitis with peritonitis. The lower

abdominal resistance which before operation was interpreted to be board-like rigidity was unquestionably the resistance offered by the spleen itself. On opening the abdomen the displaced organ was very near the anterior abdominal wall and had the muscles been relaxed, it would have been easily palpable. Under the light anæsthesia employed at the start of the operation this muscular resistance was maintained. The spleen was held by no adhesions and was easily removed from the peritoneal cavity. Its pedicle was cord-like with its base at the tail of the pancreas. There was no evidence of pancreatic tissue in the splenic stalk. This supports the writer's view that this was a case of congenital elongation of the pedicle of the spleen.

The acute tonsillitis may be mentioned as a possible etiological factor. In such acute infections an enlargement of the spleen has been observed. This enlargement and increased weight of the displaced organ may have been a contributing factor in producing the acute torsion.

Immediately following the operation there was an appreciable increase in the total number of white cells per cubic millimetre. No abnormal red blood cells were seen at any time. On the fourth post-operative day the hæmoglobin (78 per cent) and the red cells (3,920,000) had fallen to the lowest point. Following operation there was a steady decrease in the percentage of polymorphonuclear cells and an increase in the percentage of the lymphocytes. Three months after operation the hæmoglobin was 105 per cent and the red cells numbered 5,100,000. At that time the total number of white cells per cubic millimetre was 10,200 with 50 per cent polymorphonuclear cells and 42 per cent lymphocytes.

*Splenoptosis* has been found almost exclusively in the female, and it was not until 1914 that the condition was first observed in the male by Lanz. The spleen may become displaced because of a congenitally long pedicle or on account of an acquired attenuation of its ligaments. Congenital elongation of the pedicle is said to be a rare condition, but the displacement in the case herewith reported is believed to have been due to such an elongation. Of the seventy odd cases of torsion of the spleen found in the literature all but three occurred in women. General or partial vicerioptosis was associated with splenoptosis in many of these cases. According to Allbutt, of all cases of vicerioptosis only 2 per cent of the patients show splenoptosis. Pregnancy with the general relaxation of the abdominal walls favors the development of this condition and may in part explain the greater frequency of splenoptosis in women. Hypertrophy of the spleen has in many cases been a contributing factor, but many spleens enlarged by malaria and other diseases are found in normal position although enormously enlarged. Malarial spleens are, however, frequently ectopic and a number of cases have been reported in which such spleens have undergone rotation upon their pedicles.

The ectopic organ may occupy any region of the peritoneal cavity, limited in its excursions only by the length of its pedicle. The variation in position and the range of motion enjoyed by the ectopic spleen is greater than that of any other viscus. Morgagni has reported the presence of the spleen in

the sac of an inguinal hernia. During change of position the viscus may float about against the action of gravity, and Bland-Sutton has aptly compared its movement to that of a boat upon the crest of a wave, since the spleen seems to float upon the intestines. When the patient assumes the upright position, gravity plays a more important part in determining the location of the organ.

Chronic engorgement of the spleen is favored by its abnormal position and mobility, this results in hypertrophy. Traction upon the stomach and pancreas leads to recurring attacks of indigestion, with or without nausea and vomiting, and pain in the epigastrium and left hypochondrium. In one case reported by Govseieff, quoted by MacDonald and Mackay, traction coincident with acute torsion of the spleen resulted in necrosis of a portion of the fundus and the body of the stomach. Tieves has reported recurring attacks of jaundice as the result of traction exerted by a wandering spleen upon the biliary passages. Traction upon the tail of the pancreas has resulted, in many cases, in the elongation and displacement of that organ. Pancreatic tissue has been found in the stalk of the spleen in varying amounts. In some of the cases the tail of the pancreas was in contact with the hilus of the spleen and in others the extent was not so great. Pressure of the spleen upon loops of intestine and constriction of the gut by the cord-like pedicle favors intestinal stasis upon which an acute obstruction may develop. The pelvis position of the spleen has in most cases caused a retroversion of the uterus and in one case reported by Kouever there had occurred a complete prolapse of the uterus and the urinary bladder. In over 60 per cent of the reported cases of pelvis spleens the organ lay between the uterus and the bladder. On account of the pressure upon, and the displacement of, the pelvis organs, various menstrual and bladder symptoms with pelvic discomfort have been reported. In a number of cases a movable tumor has been observed in the abdomen by the physician or by the patient and at subsequent operation this tumor has proved to be the spleen. At times the wandering spleen has been observed to retreat upward under the costal margin where it remained for days or weeks. Blesh observed an abdominal tumor which increased in size with each digestive cycle and at operation this was found to be an ectopic spleen.

The gravest danger to the ectopic spleen is the acute rotation upon its pedicle, which is favored by the free mobility and increased size of the organ. Chronic torsion may exist for some time without producing changes other than congestion and consequent enlargement of the viscus. In a number of cases acute torsion has occurred following muscular effort or abdominal trauma, while in others the condition has developed without apparent cause. The symptoms are those of a major abdominal catastrophe. The onset is sudden and manifests itself by acute stabbing or cramp-like epigastric pain accompanied by nausea and vomiting. Abdominal tenderness and rigidity quickly develop. The temperature may be slightly elevated and the white blood cells are usually moderately increased in number. The patient is

severely shocked and appears acutely ill. In case an abdominal tumor has been previously observed it will be greatly enlarged if it is the twisted spleen.

The first result of the torsion is the compression of the splenic vein and the rapid engorgement of the organ. Later this is followed by occlusion of the artery with thrombotic changes and infarction of the spleen. Coincident to these vascular changes there is an abundant serous exudate poured into the peritoneal cavity. Hartmann has rightly described this condition as an aseptic peritonitis. The peritoneal fluid is at first clear, later it appears hemorrhagic or cloudy. As time goes on and if relief is not given by operative interference, a true septic peritonitis develops. During torsion one or more intestinal loops may become involved with the pedicle, as in the case of O'Shea, adding an acute intestinal obstruction to the already serious condition of the patient. In the reported cases the degree of rotation of the spleen has varied from a quarter turn to four complete revolutions upon its axis. The pathological changes in the spleen as the result of the occlusion of its vessels are well known and have varied from congestion to complete gangrene.

With few exceptions the diagnosis of this condition has not been made prior to operation. Pre-operative diagnoses have been varied and numerous, including twisted ovarian cyst, kinked hydronephrosis, acute intestinal obstruction, acute peritonitis, hæmatocele, mesenteric and omental cysts, congenital saccococcygeal tumor, acute perforation of the gastro-intestinal tract, and acute appendicitis. The knowledge of the existence of a wandering spleen previous to the onset of the acute illness would aid materially in making the diagnosis. In the few cases diagnosed this information was available. In many of the reported cases there was a palpable tumor in the abdomen, but its true nature was not suspected. In cases in which there is a palpable tumor Hartmann advises the use of Trendelenburg's position to determine the mobility of the mass and to observe its change in position. If it moves upward to the left hypochondrium, he believes that a movable spleen should be strongly suspected. Absence of attachment between the tumor and the pelvic organs if demonstrated, would rule out ovarian or uterine conditions. The wide range of motion of the tumor and the absence of urinary symptoms and meteoric colic should make kinked hydronephrosis seem unlikely. Fluoroscopic examination of the patient in the upright position would in most cases rule out perforations of the gastro-intestinal tract. In this manœuvre free gas in the peritoneal cavity is collected under the vault of the diaphragm and can be seen as a clear light crescentic area below the dark shadow of the diaphragm. In suspected cases of acute appendicitis, a test which is of value is the application of pressure over the splenic flexure of the colon with the right thigh flexed on the abdomen with the leg extended on the thigh. When the patient coughs in the presence of an acutely inflamed appendix acute pain is felt at McBurney's point. In women when the spleen occupies the pelvis the uterus is usually retroverted and the organ is palpable through the anterior vaginal wall.



The treatment of choice is splenectomy. This has been done in the great majority of the reported cases, and it has been a relatively simple operation because of the absence of adhesions fixing the spleen. In one case reported by Bland-Sutton and in another reported by Conklin, the torsion was relieved by untwisting the spleen on its pedicle. In both patients the torsion recurred and the spleen was then removed. Splenopexy offers technical difficulties in the fixation of an abnormal viscus and Hartmann believes that such fixation results in further enlargement of the organ. Treves in his *Manual of Operative Surgery* mentions the fact that he has done this operation in two cases, but there are no notes regarding the end results. The removal of the spleen when it is found twisted upon its pedicle is the only rational method of treatment. By this operation the patient is cured and there is no danger of a recurrence of this serious condition.

#### SUMMARY

1 Axial rotation of the wandering spleen is not a common condition. It has been observed in seventy odd women and in four males.

2 Torsion is favored by the free mobility of the organ and not primarily by its increased size. A certain number of patients gave a history of muscular effort or abdominal trauma before the onset of the acute torsion, while in an equal number the attack developed without apparent cause.

3 This condition produces all of the symptoms of a serious abdominal condition.

4 Occlusion of the splenic vein occurs first. This results in enormous enlargement of the viscus from passive congestion and an abundant clear peritoneal exudate. This fluid is at first clear and sterile, later it becomes cloudy, hemorrhagic and septic. The changes observed in the spleen have varied from intense congestion to gangrene of the organ.

5 Diagnosis is difficult and the condition has frequently been mistaken for twisted ovarian cyst, kinked hydronephrosis, intestinal obstruction, acute peritonitis, acute appendicitis and acute perforations of the gastrointestinal tract.

6 The most satisfactory treatment is splenectomy.

#### BIBLIOGRAPHY

- <sup>1</sup> Albert Verhändl d deutsch Gesellsch f Chir, 1885, vol xiv, pp 63-66
- <sup>2</sup> Allbutt and Rolleston System of Medicine, Lond. MacMillan and Co, 1910, vol iv, p 447
- <sup>3</sup> *Idem* Vol iii, p 869
- <sup>4</sup> Blackburn Australas Med Gaz, 1907, vol xxvi, pp 615-618
- <sup>5</sup> Bland-Sutton Brit Med Jour, 1892, vol ii, p 1334
- <sup>6</sup> *Idem* Trans Clin Soc, London, 1892, vol cxlvi, pp 46-49
- <sup>7</sup> *Idem* Brit Med Jour, 1897, vol i, pp 132-133
- <sup>8</sup> Blesh Jour Okla Med Assn, 1922, vol xv, pp 257-258
- <sup>9</sup> Brossmann Centralbl f Chir, 1922 vol xlv, pp 675-677
- <sup>10</sup> Childe Brit Med Jour, 1905, vol ii, pp 1631-1634
- <sup>11</sup> Christmann Jour Kansas Med Soc, 1915, vol xv, pp 77-79
- <sup>12</sup> Conklin Med Rec, 1894, vol ii, pp 103-105

- <sup>11</sup> Cooman's et de Cnaep Ann des Soc d'Anvers, 1869, p 361
- <sup>12</sup> Govseieff Quoted by MacDonald and Mackay
- <sup>13</sup> Finkelstein Brit Jour Surg, 1914, vol 11, pp 68-76
- <sup>14</sup> Hagen Arch f klin Chir, 1900, vol lxi, pp 188-231
- <sup>15</sup> Halban Arch f Gynaek, 1922, vol cxvii, pp 432-433
- <sup>16</sup> Hartmann Cong Francais de chir, 1895, vol ix, pp 499-505
- <sup>17</sup> Hartmann et Morax Ann de Gynec, 1894, vol ix, pp 41, 193-197
- <sup>18</sup> Heurtaux Bull et mem Soc de Chir de Par, 1893, vol xix, p 752
- <sup>19</sup> Johnson ANNALS OF SURGERY, 1908, vol xlviii, pp 50-65
- <sup>20</sup> Keen's Surgery W B Saunders Company, Phila, vol iii, pp 1068-1093
- <sup>21</sup> Idem Vol iv, pp 619-624
- <sup>22</sup> Kerr Trans West Surg Assn, 1915, vol xxiv, pp 211-220
- <sup>23</sup> Korte Berl klin Wehnschr, 1893, vol xxx, p 902
- <sup>24</sup> Koucver Quoted by Bland-Sutton
- <sup>25</sup> Lanz Centralbl f Chir, 1914, vol xli, pp 228-231
- <sup>26</sup> Laspeyres Centralbl f d Grenzgebiet d Med u Chir, 1904, vol vii, pp 148-155
- <sup>27</sup> Lawrason New Orleans Med and Surg Jour, 1888-89, vol xvi, pp 354-357
- <sup>28</sup> MacDonald and Mackay Lancet, 1909, vol 11, pp 917-918
- <sup>29</sup> Maclaren ANNALS OF SURGERY, 1910, vol li, pp 834-836
- <sup>30</sup> Malins Lancet, 1894, vol 11, pp 627-628
- <sup>31</sup> Malone Jour Tenn State Med Assn, 1925, vol xvii, pp 277-279
- <sup>32</sup> Morgagni Quoted by Moynihan in Keen's Surgery
- <sup>33</sup> Moynihan Abdominal Operations W B Saunders Company, 1916, vol 11, pp 454-457
- <sup>34</sup> O'Shea Northwest Med, 1915, vol vii, pp 139-141
- <sup>35</sup> Paterson Lancet, 1909, vol 11 pp 1496-1497
- <sup>36</sup> Petridis Lyon chir, 1918, vol xv, pp 747-759
- <sup>37</sup> Pieri Riv osp Roma, 1919, vol ix, p 238
- <sup>38</sup> Pool and Stillman Surgery of the Spleen, D Appleton and Company, New York and London, 1923
- <sup>39</sup> Pozzi Rev de chir, 1903, vol xxviii, p 405
- <sup>40</sup> Prince Jour Am Med Assn, 1915, vol lxi, pp 1571-1573
- <sup>41</sup> Rowlands Guy's Hosp Gaz, 1922, vol xxxvi, pp 513-516
- <sup>42</sup> Runge Berl klin Wehnschr, 1895, vol xxxii, p 346
- <sup>43</sup> Southam Lancet, 1921, vol cc p 642
- <sup>44</sup> Stone ANNALS OF SURGERY, 1899, vol xxx pp 321-323
- <sup>45</sup> Tice Practice of Medicine, W F Prior and Company, Hagerstown, vol viii, p 281
- <sup>46</sup> Treves A Manual of Operative Surgery 1903, vol 11, pp 476-477
- <sup>47</sup> von Salis Cor Bl f schweiz Aertze, 1913, vol xliii, pp 1669-1672
- <sup>48</sup> Warren ANNALS OF SURGERY 1901, vol xxxiii pp 513-541
- <sup>49</sup> Whitthouse Jour Obst and Gynec Brit Emp, 1913, vol xliii, pp 161-163

# SPONTANEOUS RUPTURE OF THE SPLEEN

By MICHAEL G. WOHL, M.D.

OF OMAHA, NEB

THE following case of spontaneous rupture of the spleen serves to emphasize the rarity of the condition. It is surprising that the literature on the subject offers no explanation for the occurrence of the condition in the spleen. The purpose of the present report is not only to add a new case to the literature, but also to offer an explanation for this phenomenon.

*History*—A woman, aged thirty-two years, was admitted to the service of Doctors Campbell and Sigworth in the Lutheran Hospital of Norfolk, Nebraska, with a history of abdominal pains and acute diarrhœa of seven days' standing. At the time of her admission to the hospital, the diarrhœa had apparently ceased, however, her abdominal pains continued.

*Past History*—Four years ago, in 1920, she had an attack of gastro-intestinal pains, as seen in patients with gall-bladder disease. No previous history of typhoid fever, malaria or any other ailment was elicited at that time. Cholecystectomy and appendectomy were performed at that time. After this she remained in good health until her present illness.

*Present History*—Patient was seized with an attack of diarrhœa similar to the "summer diarrhœas" that were rather common in the community during the hot summer months. Diarrhœa lasted four days. Under the usual treatment, the diarrhœa disappeared, however, her abdominal pains continued. The pain was at first limited to the gall-bladder area. Neither hot packs nor any other remedy employed brought to her any relief. Hypodermic administration of morphine was resorted to for two days. Her temperature ranged from 99.6 to 102, pulse 80-103. Blood-pressure, systolic 125 diastolic 75. She was relieved from pain for five days, soon after, the pain localized in the left hypochondrium, three days later her pain became severe and she went into shock, presenting the appearance of one exsanguinated. The examination of the heart and lungs was negative throughout. At the time of onset of shock she complained of intense aching through left shoulder. In the abdomen there was no rigidity at first, twenty-four hours after onset of shock a mass in left hypochondrium could be felt, mass of indefinite contour, very tender and some rigidity after first day.

That an intra-abdominal hemorrhage had taken place was evident. On opening the abdomen an estimated amount of 700 c.c. of blood and clots were found free in peritoneal cavity. The bleeding was from spleen, which organ was adherent to the diaphragm by rather dense fibrous bands. After a transfusion of 600 c.c. of blood, splenectomy was done. The patient made an uneventful recovery and left the hospital at the end of three weeks.

*Pathological Report*—Spleen weighs 230 grams, is of grayish color, capsule wrinkled, and in several places shows soft fibrinous tags. The spleen is notched having five distinct notches. Between two of these there are seen sub-capsular hemorrhages, at the bleeding points the capsule is torn, the tears extending into the interior of the organ. Upon incision the pulp is soft, a gray-red in color, trabeculae not visible, Malpighian bodies obscure, granular material can easily be scraped off from surface of spleen.

Microscopical examination shows capsule to be thickened and in places to have undergone hyaline changes. No nuclear structures of fibroblasts can be made out, throughout the capsule there are seen a number of large polymorphonuclear leucocytes.

## SPONTANEOUS RUPTURE OF THE SPLEEN

containing pigment (hæmosiderin), likewise there is scattered throughout the capsule free pigment. The pulp is the seat of many mononuclear and endothelial cells, there are also seen a number of polymorphonuclear leucocytes, and red blood cells. The media of the blood-vessels are thickened and reveal hyaline changes, the endothelial cells of the intima are proliferated, giving the picture of being lined by large epithelial cells. The lumina of the blood-vessels are filled with free red blood cells and leucocytes.

*Comments*—Rupture of the spleen is of infrequent occurrence. Crawford<sup>1</sup> states that out of 16,000 post-mortems he has only observed one case. Noland and Watson<sup>2</sup> have found only three instances of spontaneous rupture of the spleen out of clinical and autopsy records of approximately 30,000 malaria cases admitted to the Colon Hospital of Panama Canal zone during eight years.

This great rarity does not apparently represent the true incidence of the condition. The disease is of surgical nature and the surgeon rather than the pathologist would be more apt to see these cases. Secondly, since the introduction and the improved technic of splenectomy and blood transfusions in these cases, the number of recoveries have increased. Thus Leighton<sup>3</sup> gives a mortality rate of 12.44 per cent of cases operated on by five different surgeons. Biogstein,<sup>4</sup> in 1909, reviewed the literature on traumatic rupture of the spleen and stated that up to date there has been reported 203 cases treated by surgical means. The mortality after splenectomy was 35.5 per cent for rupture of previous normal spleen and 33.3 for diseased spleen. Baines<sup>5</sup> analyzed the literature since Biogstein's paper and found the mortality to be 7.6 per cent, a rate more in accordance with that of Leighton. The discrepancy in the figures can be accounted for by the difference in the pre-operative condition of the patients. The majority of the cases reported can be traced as distinctly resulting from some form of trauma, occurring in persons with a previous diseased spleen. The Orient claims a great percentage of the reported cases. This is most likely due to the fact that natives have large spleens probably on account of the prevalence of diseases in the tropics, that are associated with splenomegalia, such as malaria, Kala-azar, Malta fever, relapsing fever, etc. Berger<sup>6</sup> collected 123 cases of traumatic rupture of the spleen and out of this number 99 cases showed malaria. It is interesting to note that the cases reported by McCracken<sup>7</sup> and Price<sup>8</sup> came from Shanghai which according to the former suggests the possibility of modern industry having a bearing upon the more frequent occurrence of rupture of the spleen in the seaport of Shanghai.

The occurrence of spontaneous rupture of previously healthy spleen during an acute illness is exceedingly uncommon. We were able to collect from the literature twenty-seven cases. The case reported above would bring up the total to twenty-eight cases. This group includes the fourteen cases that occurred during the course of typhoid fever thirteen of which were recently collected by Melchior.<sup>9</sup> Additional cases were reported since by Shorten<sup>10</sup> and Diehl.<sup>11</sup>

The function of the spleen is still a mooted question, yet there are a number of true facts known regarding the changes the spleen assumes in certain pathologic states of the body, and *vice versa* changes in other organs that are brought about by disease in the spleen as well as following removal of the organ that we cannot help but realize that the spleen as an organ is exposed to continual wear and tear. A detailed discussion of the various functions of the spleen has been considered by the author<sup>12</sup>

Indeed the histological study of the latter offers proof for the early aging of the organ. Gross<sup>13</sup> finds that from the age of thirty on, the capsule in practically every spleen studied reveals considerable hyaline changes of its connective tissue. The nuclei of the fibroblasts disappear and the fibrils become thickened and few. The blood-vessels likewise undergo a gradual thickening, particularly of the media and intima, consisting of connective tissue and hyaline. This is rather remarkable that a splenic blood-vessel should undergo hyaline changes at such an early life.

The capillaries that permeate the Malpighian corpuscles become thickened and later hyaline so that at thirty-six years practically 50 per cent of spleens show instead of one arteriole, a number of more or less thickened and tortuous vessels coursing through each Malpighian corpuscle.

The amount of lymphoid tissue falls steadily from birth, because of the gradual collapse of the tissue, however, there appears gradual increase of pulp with increasing years. Because of these changes there occurs a decrease in the power of constructive metabolism, which factor contributes to the senescence of the organ. This is in accordance with Child's observation,<sup>14</sup> that anything that decreases the rate of metabolism such as decrease in permeability, increase in density, accumulation of relatively inactive substances leads to senescence.

During the course of an acute infection, such as typhoid where the spleen is large and red or other bacterial infections associated with a large gray spleen, there is a predominance of large mononuclear cells with an increase of the protoplasmic rich pulp cells in the former, and an increase in polymorphonuclear, pulp cells and endothelial cells in the latter, thus the spleen enlarges, giving rise to the splenic tumor of the acute infections. In a person past thirty years of age, the spleen by virtue of the histological changes incident to its aging, as indicated above, would be more apt to rupture, particularly if trauma or even too violent a palpation of the organ are applied. The reported cases of ruptured spleens would bear out this point, the average age reported being 37.6 years.

The histological picture of spleen of our case shows distinct hyaline changes of its capsule, the blood-vessels are thickened and likewise reveal hyaline changes.

As a practical point it would appear that one should exercise care not to palpate the spleen too violently during the course of acute illness, particularly in a patient past the age of thirty-six years.

# SPONTANEOUS RUPTURE OF THE SPLEEN

## CONCLUSIONS

1 Spontaneous rupture of the spleen is of infrequent occurrence, there being twenty-eight cases described in the literature

2 The probable explanation for the occurrence of the condition in the spleen is to be found in the hyaline changes of the capsule and blood-vessels incident to aging of the organ

3 Too violent palpation of the spleen in patients with acute infection should be avoided, particularly when the patient is past thirty years of age

## REFERENCES

<sup>1</sup> Crawford ANNALS OF SURGERY, vol lxxiv, p 16, 1921

<sup>2</sup> Noland and Watson ANNALS OF SURGERY, vol lvii, p 731, 1913 Quoted by Leighton, *loc cit*

<sup>3</sup> Leighton ANNALS OF SURGERY, vol lxxiv, 1921

<sup>4</sup> Brogister Quoted by Willis Surg, Gyn and Obst, vol lxxix, 1919

<sup>5</sup> Barnes Quoted by Willis Surg, Gyn and Obst, vol lxxix, 1919

<sup>6</sup> Berger Archiv fur Klin Chirurgie, vol lxxiii, p 778, 1902

<sup>7, 8</sup> McCracken and Price ANNALS OF SURGERY, vol lxxix, January and June, 1924

<sup>9</sup> Melchoir Centrabl F D Grenzg Derr Med u Chir, 1911, vol xiv

<sup>10</sup> Shorten Brit Med J, Dec 27, 1919

<sup>11</sup> Diehl J Amer Med Assoc, March 22, 1924, p 952

<sup>12</sup> Wohl Pathologic Physiology of the Spleen Nebr Med Journal, May, 1925

<sup>13</sup> Gross Journal of Medical Research, 1918-19, vol lxxix, p 311

<sup>14</sup> Child Arch Entw Mech, vol lxxvi, 1911, quoted by Conklin, Harvey Lectures, 1912-1913

# DIVERTICULA OF THE JEJUNUM\*

By NORMAN S. ROTHSCHILD, M.D.

OF PHILADELPHIA, PA.

FROM THE SURGICAL SERVICE OF DR. J. H. JOPSON, HOSPITALS OF THE GRADUATE  
SCHOOL OF MEDICINE, UNIVERSITY OF PENNSYLVANIA

THE basis for this paper is the presentation of the following case

K. G., female, housewife, age sixty-three, was admitted to the service of Dr. J. H. Jopson with a history of having had pain in the stomach for the past fifteen or sixteen years. Pain was cramp-like in character, continued to move across upper abdomen and radiate to left shoulder blade. It would appear two to three hours after eating. These pains would come and last four to six weeks and disappear for a year or more, only to return. In October, 1922, she again began to suffer from her gastric pains. They were again of the same character as before. Since December, 1922, she began to have a feeling of fullness and frequency of vomiting. Vomiting would occur without relation to meals, being preceded by severe attacks of cramp-like pain.

During the interval between October and December, she was treated medically and considerably relieved until the present time. She has not lost weight.

**Previous History**—She had several diseases of childhood, she can remember no other illness. She was operated upon by Dr. J. G. Clark for internal injuries following transverse presentation.

**Family history** is negative. She has five children living and well. Two children died, one of croup, another of diphtheria.

**Physical examination** revealed a female adult, about sixty years of age, head negative, chest and heart negative, Abdomen. Slight areas of tenderness in the epigastric region, a little to the left of the midline, slightly above the umbilicus. She had no gall-bladder tenderness. Kidneys were negative, as was the appendix. Pelvic examination was negative.

**Urinalysis** was negative for albumin and sugar. Microscopically showed occasional leucocytes and many squamous epithelium. Blood count showed 4,740,000 reds, leucocytes 6300 and 80 per cent hæmoglobin. Differential blood count showed 42½ per cent small lymphocytes, 1 per cent large lymphocytes, 2 per cent transitionals, 49 per cent polymorphonuclears, 4 per cent eosinophiles and 1½ per cent basophiles. Feces was constantly positive for occult blood. Special examination of the blood revealed Sugar 108—Creatinine 2.1,—Uric Acid 4.2—Urea 23.

**X-ray Examination**—Report from Doctor Campbell was as follows: "Stomach filled normally and showed no evidence of organic lesion. Greater curvature about 5 inches below iliac crest in the erect posture. No retention at the six-hour period although peristalsis was sluggish and waves shallow. There is a retention of a portion of the barium meal in the small intestine, apparently near the duodeno-jejunal junction which is constant (Fig. 1). It may be due either to a diverticulum at this location or old inflammatory adhesions, or a perforated gastric ulcer. In the erect posture the entire colon lies below the iliac crest."

She was operated upon April 18, 1923. Findings at operation were as follows: The liver was ptosed, stomach markedly ptosed. There was an old healed constricting ulcer at the pylorus, stones size of grapes were in the gall-bladder. The jejunum was angulated about four inches below its origin, due to the presence of a diverticulum extending behind the stomach and to the right of the ligament of Treitz, which on being dissected out from its position, to which it was adherent, measured approximately 1½

\* Read before the Philadelphia Academy of Surgery, April 6, 1925.

## DIVERTICULA OF THE JEJUNUM

inches in all diameters, being circular in shape, with very broad vessels, communicating by a wide opening with the jejunum on the antimesenteric border 4 inches below the duodeno-jejunal flexure. This explains the persistent shadow in the X-ray above the stomach. The diverticulum was thick-walled, and on section showed a mucosal lining and a fibrous outer coat.

Cholecystectomy and appendectomy were performed in the usual manner, the diverticulum was removed at its base and this opening used in performing a posterior gastro-jejunostomy. Patient made an uneventful recovery and was discharged on the 9th of May 1923.

From the articles by Balfour, Helvestine, Watson and others we have been able to collect thirty-three cases of diverticula of the jejunum. Of this

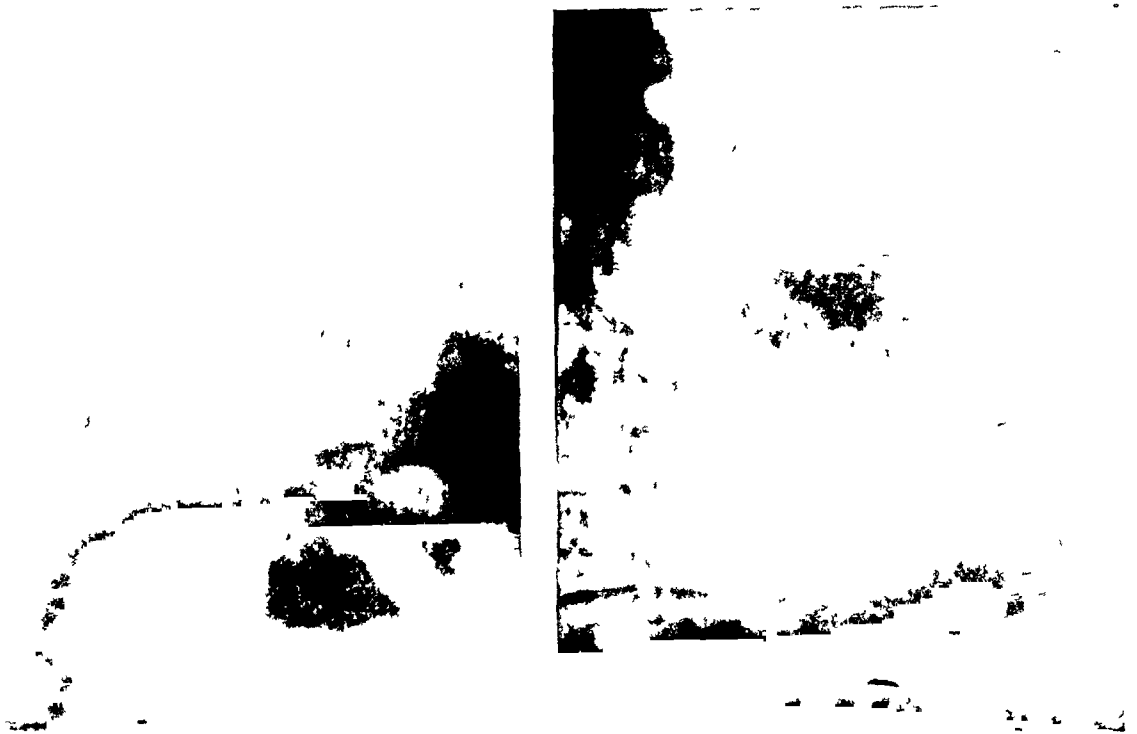


FIG. 1.—Congenital diverticulum of the jejunum in an adult female. It was associated with pyloric stenosis from ulcer and calculous cholecystitis. Diagnosis of probable diverticulum by Dr. Campbell. Resection of diverticulum, gastroenterostomy, cholecystectomy, Appendectomy. Recovery. (From Hospitals of the Graduate School, University of Pennsylvania.)

number twenty-one were discovered at necropsy, ten at operation, and no notation of how ascertained in the remaining two cases.

Diverticula may be classified as true and false. The histology of the true type consists of all the coats of the intestine, while the false type lacks the muscular layer. Where this fact was mentioned in the reported cases, there were three true diverticula and eleven of the false type of diverticulum. They were found on the mesenteric border in twenty-one cases and on the antimesenteric border in three cases.

Numerous etiological factors have been considered as responsible for their production. Klebs believed that traction on the intestine by the mesentery was the causative factor. Hauseman attributed them to increased intra-intestinal pressure from the accumulation of gas or fecal material. Graser, to venous congestion causing separation of the muscles of the intestine with a subsequent herniation of the mucosa. Roth considered fatty degeneration of the tunica



NORMAN S ROTHSCHILD

TABLE I

Reported by	Date	Ascertained	Age	Sex	Number	Type	Size	Location	Symptoms
Sir Astley Cooper Cornillon Sir Wm Osler	1844	Necropsy	50	Male	Multiple	False	Pea to walnut	Mesenteric	None
	1869	Necropsy	30	Female	Single	False	Hen's egg	Mesenteric	None
	1881	Necropsy	65	Male	Multiple	False	Cherry to apple	Mesenteric	Complained of rumbling sounds and colicky pains after eating
Moore Buzzi Buchwald and Janicke Virchow Edel M Seippel Latarjet and Murad Brathwait	1883	Necropsy	40	Male	Multiple	True		Mesenteric	None
	1885	Necropsy	77	Male	Single	True	23 x 32 mm	Mesenteric	None
	1887	Operation	6	Male	Single	True		Mesenteric	Intestinal obstruction
	1890	Necropsy		Male	Multiple	False	Hen's egg	Mesenteric	None
	1894	Necropsy	73	Female	Multiple	False	Walnut to apple	Mesenteric	None
	1895	Necropsy		Female	Multiple	False	Walnut	Mesenteric	None
	1914	Necropsy	50	Female	Single	?	2 5 x 5 cm	Mesenteric	?
	1918	Necropsy	45	Male	Multiple	?	Largest 2 5 cm diameter	Mesenteric	?
	1920	X-ray and operation	61	Male	12	?	One 5 cm diameter	?	Gastric discomfort and intestinal flatulence
Case	1920	X-ray and operation	73	Male	?	?	?	?	Patient was operated on for gall-stones Diverticulum not removed
Terry and Mugler	1921	Found at operation for duodenal ulcer	59	Female	Multiple	?	?	?	1 1/2 years after operation for ulcer, developed intestinal obstruction due to enterolith in diverticulum
									?
McWilliams	1921	Necropsy	71	Male	Multiple	?	?	Mesenteric	Incomplete intestinal obstruction
Mackenzie	1921	Operation	43	Female	Multiple	False	Split pea to pig-con's egg	Mesenteric	?
Good	1895	?	77	Female	Multiple	False	?	Mesenteric	None



muscularis a sufficient cause, while Sudsiki believed diminished resistance of the connective tissue about the veins was a predisposing factor Helvestine believes there are three factors operating conjointly in the formation of acquired diverticula 1 Traction by mesenteric vessels or traction following adhesions 2 Degeneration of intestinal muscularis 3 Intra-intestinal pressure

It is more frequently observed in individuals past the fiftieth year of life In this series seventeen of twenty-six previously recorded ages were past fifty and of the seventeen, nine, or slightly more than fifty per cent, were found in individuals between seventy and eighty years of age One case that of Buchwald and Janicke, was six years old and one of Hansemann's cases was a boy of fourteen There were nineteen males and ten females The size varied from that of a pea to an apple They appeared as single diverticula or multiple

The symptoms may be acute or chronic The acute symptoms are usually those of acute intestinal obstruction This condition existed in the cases of Buchwald and Janicke, Gordinier and Sampson and Terry and Mugler and in each case a diverticulum containing fecal material or an enterolith was the cause of the acute intestinal obstruction Four of the cases presented the symptoms of chronic intestinal obstruction They complained of loss of weight, abdominal pain, and some constipation Three cases presented other pathological conditions two associated with ulcers of the stomach and duodenum and one with gall-stones

Balfour was forced to do an anterior gastro-enterostomy in a case of gastric ulcer because of adhesions between the diverticulum of the jejunum and the colon Terry and Mugler operated on a case for duodenal ulcer and one and one-half years later operated for acute intestinal obstruction caused by an enterolith in a jejunal diverticulum A patient, reported by J I Case was operated upon for gall-stones and a large diverticulum of the jejunum confirmed, which had previously been diagnosed by X-ray examination

But three previous cases were diagnosed before operation by means of X-ray, two by Case and the other by Baastrup

The surgical treatment consists of the choice of three procedures first, inversion of the sac, second resection of the sac, and third, where the involvement is extensive, resection of the affected portion of intestine

*Conclusions*—It is evident from the analysis of the previously reported cases and our own that diverticula of the jejunum may cause symptoms acute and chronic, but that no definite symptom complex can be attributed to their presence Also that pathology of the stomach, gall-bladder and duodenum may be associated with this condition and only by means of a careful gastro-intestinal X-ray study may it be revealed before operation

#### BIBLIOGRAPHY

- Baastrup, Christian J Ugeskuft for Laeger Feb, 1924 p 180  
 Balfour ANNALS OF SURGERY, 1923, vol LVII, p 902  
 Braithwait, V Guy's Hosp Gaz, 1918 vol XXVII p 77  
 Buchwald and Janicke Deutsche Med Wchnschr, 1887, vol VI, p 868

# DIVERTICULA OF THE JEJUNUM

- Buzzi Arch f Path Anat, 1885, vol c, p 357  
 Case, J F J A M A, 1920 vol lxxv, pp 14-36  
 Chlumsky Beit z Klin Chir, 1899 vol xv  
 Cooper, Sir Astley The Anatomy and Surgical Treatment of Abdominal Hernia,  
 Lea & Blanchard, 1844, p 364  
 Cornillon Bull Soc Anat de Par 1869, vol xlv, p 525  
 Eddel M Arch f Path Anatomy, 1894, vol cxlv, p 400  
 Fischer J Exp Med, 1901, vol v, p 333  
 Good Inaugural Dissertation, Zurich, 1895  
 Gordiner and Sampson J A M A, 1906, vol xlv, p 1585  
 Graser Arch f Klin Chir, 1899, vol lx  
 Grassberger Wien Klin Wchnschr, 1897, vol x, p 149  
 Hansemann Arch f Path Anatomy, 1896, vol cxviii, p 347  
 Helvestine, F, Jr Surg, Gyn and Obs, vol xxxvii, 1923, 3, p 1  
 Hunt, E L, and Cook, P K ANNALS OF SURGERY, vol lxxiv, 1921, p 746  
 Klebs Handb f d Path Anat, 1869, vol i, p 271  
 Latarjet and Murad Lyon Chir, 1914, vol xl, p 425  
 MacKeehme ANNALS OF SURGERY, 1921, vol lxxii, p 96  
 McWilliams, C A ANNALS OF SURGERY, Jan, 1921  
 Moore, N Brit N J, 1883, vol ii, 1920  
 Neumann Arch d Hollande, 1870, vol xi, p 200 (cited from Fischer)  
 Nichols, A G Montreal M J, 1899, vol xxxiii, p 387  
 Rokitsansky Lehrb d Path Anat, 1856, vol ii, p 36  
 Roth Arch d Path Anat, 1872, vol xli, p 197  
 Scuppel Inaugural Dissertation, Zurich 1895  
 Sheppe J A M A, vol lxxvii, pp 1118-1119, April 5, 1924  
 Sudsiki Langenbeck's Arch f Klin Chir p 708, 1900  
 Taylor and Lakin Lancet 1910, vol i, 495  
 Terry and Mugler Arch Surg 1921, vol ii, p 345  
 Virchow, R Verhanded Berl Med Gesellsch, 1890, p 116  
 Watson, C M Surg, Gyn and Obs, 1924, vol lxi, p 71

## APPENDICITIS AND TRANSPOSITION OF THE VISCERA\*

By BIRD CHARLES WILLIS, M D

OF ROCKY MOUNT, N C

IN A series of 10,000 patients admitted to Park View Hospital previous to November 1, 1924, three were found to have total transposition of the viscera. One of these had been operated on elsewhere for acute appendicitis and had two operative scars, a right McBurney and a median. Both of the incisions were made during the same operation.

St Clair, in 1915, stated that approximately 300 cases of complete transposition of abdominal viscera had been reported in the literature to that date. Six of these had been observed at the Mayo Clinic, and in three operation had been performed for left-sided appendicitis. Total transposition of the viscera is not found in all cases of left-sided appendicitis.

Karewski divides the causes of sinistroposition into congenital and acquired, and the causes of left-sided appendix into (1) total transposition of the viscera, (2) primary, solitary transposition of cæcum and appendix, (3) excessive length of the appendix which extends behind the bladder transversely through the pelvis, and (4) a normally located but mobile cæcum with an adhesive type of appendicitis, whereby the appendix is diverted to the left side of the body.

I have been able to find reported in the literature fifteen cases of appendicitis with complete transposition of the viscera. They are briefly summarized as follows:

CASE I—A married woman, aged twenty-two, was operated on for chronic appendicitis through a median incision. The cæcum and appendix were found in the left iliac fossa. The appendix was removed and the patient recovered. (Christie, G W, *Lancet*, 1916, vol 1, p 676)

CASE II—A boy, aged fifteen, with transposition of the viscera, was operated on for acute appendicitis. He had had pain in the left lower abdomen. No mention was made of the site of the operation or the history of the case following operation. (Franke, F, *Munchen med Wchenschr*, 1922, vol 11, p 786)

CASE III—A boy, aged sixteen, with transposition of the viscera, was operated on for acute appendicitis through a median incision followed by a left incision. The patient recovered. (Hebblethwaite, H, *Brit Med Jour*, 1907, vol 11, p 1579)

CASE IV—A man, aged twenty-four, was operated on for abscess of the appendix on the left side. An incision was made through the left rectus, corresponding to the McBurney incision on the right. Drainage was instituted. The patient's recovery was uneventful. (Jacobson, J H, *Am Jour Obst*, 1917, vol 11, pp 953-958)

CASE V—A woman, aged fifty (observed in 1883), died from perforative peritonitis, without operation. She had had severe pains on the left side. Necropsy revealed the appendix in the left hypochondrium and typical transposition of the viscera. (Landgraf)

CASE VI—A woman, aged twenty-five, was observed in 1918. An X-ray examination was made of her stomach and the transposition of the viscera found. Her physician was notified one and one-half years later that she had been operated on. No further

---

\* Read before the Seaboard Medical Association, December 4, 1924

information was obtained (Landgraf H, *Munchen med Wchnschr*, 1922 vol lxx, p 513)

CASE VII—A patient with transposition of the viscera. The history and physical findings were typical of acute appendicitis with abscess. There was pain and tenderness and a mass on the left side. Operation was performed through an incision 4 cm to the right of the umbilicus. (Lyle H H M, *ANNALS OF SURGERY*, 1916 vol lxxii p 124)

CASE VIII—A man aged twenty-one, who had known since the age of fifteen that he had transposition of the viscera, was operated on for appendicitis through a left-side incision. Results were not stated. (Muhlsam, R, *Deutsch med Wchnschr*, 1912, vol i p 953)

CASE IX—A woman, aged forty-two, had pain in the left side. A diagnosis was made of the transposition of the viscera and appendicitis. No operation was performed. (Podewin and Defour, *Bull et mem Soc med d hôp d Par* 1913 vol xxxv, pp 215-217)

CASE X—A boy, aged fourteen, was seized suddenly with pain in the abdomen. There was general muscular rigidity with

marked tenderness. FIG. 1—Rontgenogram of the thorax showing the dextrocardia and the general reversal of the domes of the diaphragm.

runts more pronounced on the right than on the left. The diagnosis was made of diffuse appendiceal peritonitis but transposition of the viscera was not suspected. Two incisions were made, one in the right lower quadrant and the other a left McBurney. The patient recovered. (Pool E H, *ANNALS OF SURGERY*, 1912 vol lxi, pp 940-942)

CASES XI, XII and XIII—In these three cases operations for left-sided appendicitis were performed at St. Mary's Hospital (Mayo Clinic). In two there was an acute abscess of the appendix. (St. Clair)

CASE XIV—A man, aged twenty-seven, suffered from nausea, general abdominal pain and vomiting. There was muscular rigidity over the lower half of the abdomen more pronounced on the left side. The diagnosis was made of ruptured gangrenous appendix, probably with localized abscess in the left iliac fossa. Operation was performed through a right rectus incision under ether anaesthesia. The patient recovered uneventfully. (St. Clair R, *Bost Med Times* Denver 1915-1916 vol xxx p 322)

CASE XV—A married woman, aged eighteen, had pain in the middle of the abdomen with tenderness and rigidity of the left rectus. A diagnosis of acute gangrenous appendi-

citis was made. Operation was performed through a median incision. Death occurred from general peritonitis fifteen days later. (Palamountan, W B, *Jour Am Med Assn*, 1915, vol LIV p 1986)

From the various sites of the incisions in these fifteen cases and the necessity in three cases of making a second incision, it would appear that the surgeons in most of the cases had either not appreciated that they were dealing with patients having transposition of viscera or felt uncertain of the

diagnosis. The lesion in cases in which the location was definitely stated, was found in the left iliac fossa and could have been more readily reached through a left rectus or McBurney incision preferably the latter.

REPORT OF ADDITIONAL CASE—D C aged nineteen, a farmer was referred to the Park View Hospital, April 27, 1924, by Dr W E Warren and the following history obtained. In December, 1923, the patient began to have pain which started gradually

FIG 2 —Rontgenogram of the large intestine after barium enema showing the descending colon and sigmoid on the right side

around the navel, became general but did not extend into the epigastrium. He was not nauseated unless he took something to ease the pain. The pain usually lasted two or three hours, incapacitating him about half a day. Afterward there was soreness in the median line. He had had three or four attacks, the last one beginning two days before his admission to the hospital. He was awakened in the night by pain and nausea and tried to vomit, but was unable to do so. The pain was severe until noon the next day when it gradually subsided, leaving a soreness in the lower abdomen. There was no pain or tenderness in the right side. He had a chronic cough, spitting up about four ounces of thick pus each morning which he has done since he was a child. The balance of his history had no bearing on his present illness.

Physical examination revealed the patient to be poorly nourished, anæmic, acne-scarred, with enlarged tonsils, carious teeth, pyorrhœa of gums, and foul breath. His chest was thick and expansion poor. Resonance was normal to percussion, and auscultation revealed rales over the bronchi on both sides. Fremitus was normally distributed.

## APPENDICITIS AND TRANSPOSITION OF VISCERA

The heart was normal but was transposed the apex being felt and heard at the fifth interspace at the right of the median clavicular line. There were no thrills or murmurs. The first sound was of fair quality the second was not accentuated. The systolic blood-pressure was 100 the diastolic was not obtained as pulsation could be heard normally over the course of the vessel. The abdomen was flat the costal angle broad the umbilicus normal and the walls firm. There was very little gas and no fluid. The liver spleen and kidneys were not palpable. There was no gurgling. There was tenderness around and below the umbilicus but no rigidity or mass. The erythrocytes numbered 18000, the sputum was negative for tuberculosis bacilli, the urine was amber and clear, the specific gravity was 1.024, it contained acid, a faint trace of albumin, sugar, pus, six cells to a low-power field and a few blood cells. Rontgenograms revealed dextrocardia with pronounced thickening around the hilus of the left lung suggestive of tuberculosis (Fig 1). X-ray examination of the bowel with a barium enema disclosed transposition of the intestine (Fig 2). A diagnosis of left-sided appendicitis was made.

In view of the condition of the chest it was thought best to delay operation in the hope that operation might be performed under a local anæsthetic as it was feared that a general anæsthetic might further complicate conditions in the chest. The patient was accordingly put on rectal tap. Nothing was given by mouth for a few days, then water and a liquid diet were allowed. May 5 the leucocytes and temperature had dropped to normal, acute symptoms had subsided and the patient was considered ready for operation.

Morphin,  $\frac{1}{4}$  grain and atropin, 1/100 grain were given. The skin of the abdomen was cleansed with gasoline and iodin and infiltrated with 0.5 per cent procain at the left McBurney down through the muscles to the peritoneum. On opening the peritoneum the cæcum and appendix were readily found. The meso-appendix was infiltrated with procain and removed almost painlessly.

The appendix was about 7.5 cm in length, and definitely thickened. The vessels were moderately corrugated, and there were some adhesions near the base. The distal half was distended to twice the size of the proximal half. The lower foot of the ileum was examined for abnormalities but none was found. The ileocæcal valve was on the inner side of the cæcum and the appendix was in normal relation to the ileocæcal valve. The cæcum was as normally placed in the left iliac fossa as in its usual position in the right. The patient convalesced uneventfully and left the hospital eight days after the operation.

### CONCLUSIONS

1. Patients with left-sided symptoms and clinical findings suggestive of appendicitis should be carefully examined for transposition of the viscera.
2. In cases of appendicitis and transposition of the viscera the incision should be made to the left of the umbilicus.



# THE "LIGATION AND DROP" TREATMENT OF THE APPENDECTOMY STUMP<sup>1</sup>

RESULTS OF 3500 CASES

By JOHN J. MALONEY, M.D.

OF CINCINNATI, OHIO

IN THE present-day discussions of intricate and ultra-scientific surgical subjects it may not be amiss to occasionally turn our attention to some of the lesser and more common surgical procedures to see if by some slight change of technic, we might not better our results or reduce the operative mortality rate.

In reviewing the subject of this paper, we note that a great majority of the surgical profession have marked prejudice against such procedure. We hope that this paper will at least lessen the prejudice, even though the method may not be adopted. It is always the case that one will not change any procedure if the results are not unnecessarily bad. More so is this the case in any surgical procedure. Many men, old in the practice of surgery, are still using methods now obsolete to some of us. We believe that these obsolete methods oftentimes are being used, not because they really are the best, but because the surgeon is not prone to give up a procedure to which he has become accustomed. Changes in surgical technic are not brought about in the measurement of years but rather by the decades of years, so that eventually we think this method of operation shall be a universal procedure.

The ideal method of appendectomy is that method which removes all the appendix with the lowest operative mortality and the lowest morbidity rate. The essential point of any appendix operation is the treatment of the stump of the organ (Haggard<sup>1</sup>). Operations on the appendix have varied from the inversion of the whole appendix into the lumen of the cæcum as advocated by Edebohl,<sup>2</sup> up to the resection of the stump in the cæcum and the consequent closure of the opening as an intestinal wound. This was originally taught by Deaver.

At the present time there are essentially two methods of treating the stump after an appendectomy.

(1) "The Ligation and Drop" method, leaving the stump free in the abdominal cavity.

(2) "The inversion or burying of the stump" method, whether this consists of pure inversion of the stump or covering the stump with a peritoneal cuff.

By the quotation of some statistics, we shall attempt to show the advantages of the "ligation and drop method" over the other procedure.

In a review of the literature, we have been unable to find the originator

---

\* From service of Jos. L. DeCourcy.

of this operation, although claimed by Wyeth. This method has been universally used at Mount Sinai Hospital (New York) on thousands of cases, with never a cause for regret. (Elsberg ')

The advantages of the "ligation and drop" method are as follows:

(1) The rapidity and ease of performance. (2) Universal adaptation to all cases. (3) Lessened percentage of faecal fistulae. (4) Lessened gas pains and ileus post-operatively. (5) Absolute lack of adhesions. (6) No chance for hemorrhage from the stump.

The advantages are plainly manifest. In a consecutive series of thirty-five hundred appendectomies, all these advantages have been proven. In this series of cases there have only been ten faecal fistulae, all in the acute cases. This more than disproves the old prejudice of some surgeons, "That to drop the stump without inversion is murder." The silk ligature used in this procedure does not slough until union has taken place. According to Lilienthal,<sup>4</sup> when the stump is dropped into the peritoneal cavity adhesions form readily to its free surface, then the stump and the silk ligature slough off, leaving a perfectly clean stump. This has been amply verified in our reoperative and post-mortem findings. In reoperative cases where an appendectomy had previously been done, there have never been any adhesions, nor has the appendix scar ever been visible. The lack of post-operative adhesions lessens the morbidity rate to practically nil. In appendectomies, we never have cases of post-operative ileus (except in cases of generalized peritonitis). We attribute this to the lack of trauma to the caecum and other operative trauma.

In another observed series of cases, done by the so-called "inversion" method, the percentage of post-operative ileus is rather high. A certain definite proportion of cases, 16 per cent., according to Monks and Blake<sup>5</sup> in six hundred and fifty autopsies, have a small artery running parallel to the appendix and beneath its peritoneal coat. It is impossible to occlude this artery, except by crushing or ligating the stump. In this method of appendectomy, the artery is securely tied and all danger of post-operative hemorrhage from this source is obviated.

Wyeth was never able to find one case of post-operative hemorrhage after the appendix stump had been tied alone with silk. Deaver,<sup>6</sup> in a recent paper reported 5 per cent. of faecal fistulae in acute cases of appendicitis. In our series of six hundred acute appendectomies there have only been ten faecal fistulae. None of these required future operation. All of these cases were operated by the simple ligation and drop method.

The fact of the proven advantages of this operation seem to us sufficient reasons for its more generalized use. The two main reasons for not using this method as advanced are:

(1) The claim that mucosa will not unite to mucosa of the appendix stump. Seelig<sup>7</sup> has demonstrated the exact process. The silk ligature causes a pushing back of the mucosa when tied so that serosa is actually brought into contact with serosa causing firm healing.

(2) MORRIS, quoted by Haggard and Seelig, claims that this tight ligature causes a compression anemia, and this allows a fertile field for bacterial growth. Seelig, to disprove this theory, tied off the appendix with silk and then cauterized the stump. The intact organs were then turned over to a bacteriologist for culture. The stumps were always sterile. Clinical experience in this series of cases has proven that the stump either must be sterile or else the peritoneal cavity is sufficiently bactericidal to destroy the few organisms present. We have never had one case where there was no pre-operative peritonitis that developed the condition post-operatively.

This is sufficient proof that the stump is thoroughly cauterized and the so-called compression anemia is not a cause for bacterial growth.

The disadvantages of the so-called inversion of the stump method: (1) *More time required for operation.* (2) *The method is not universally applicable.* (3) *There is increased trauma to the tissues.* (4) *An increased number of faecal fistulae.* (5) *The method is unphysiological—usually.* (6) *More danger of hemorrhage from the stump, especially where the stump is not tied.* (7) *A potential infected stump is buried in a closed cavity.* (8) *The likelihood of inflammatory (foreign body) tumors of the cæcum.*

Originally the primary purpose of the inversion method was to turn the stump into the cæcum. This was physiological and surgical. At the present time a caucus of the leading surgeons discloses the fact that Ochsner<sup>8</sup> is the only one using such a method. As mentioned previously, Edebohl<sup>9</sup> inverted the whole appendix into the lumen of the cæcum after tying off the meso-appendix. When asked what happened to the organ, he replied that he didn't know and didn't care.

Due to hemorrhage from the artery running parallel with the appendix it was decided to tie the appendix and then attempt to insert the stump into the lumen of the cæcum. This was impossible, and thereby the primary purposes of the operation were defeated. (Cases of hemorrhage where the stump had not been tied are reported by Charles Mayo, Elsberg and Judd<sup>10</sup>.) With the tying of the stump no drainage occurred into the cæcum until the ligature sloughed, if eventually it did slough. Instead of an inversion method we have a burying method—closing in a potentially infected stump in a closed cavity, a pouch of the cæcal wall. This is absolutely unphysiological and to our mind, extremely unsurgical. The method whereby a peritoneal cuff is formed and then tied over the stump is practically the same as burying the stump in the cæcal wall. Concerning this method, Professor Riedel,<sup>10</sup> quoted by Seelig, states: "I consider the suturing of a peritoneal cuff over the appendix stump as a very dangerous procedure. As regards going so far as to bury the infected stump into the cæcal wall, this must absolutely lead to perforation into the lumen of the cæcum. If the inverting sutures hold and adhesions are strong enough, we need not fear an intraperitoneal rupture, but need only consider the disadvantages resulting from an ulcer in the cæcum as a result of the intracæcal rupture."

## TREATMENT OF THE APPENDECTOMY STUMP

Concerning the formation of foreign body tumors where inverting sutures of silk or linen have been used, we have seen the development of three such tumors about the cæcum due to such causes

### CONCLUSIONS

(1) The ligation and drop method of appendectomy is the ideal procedure because it is more easily and readily performed with lessened mortality and morbidity rate

(2) Any method of burying the stump in the cæcal wall is unphysiological and unsurgical and is followed by a greater percentage of complications and sequelæ

### BIBLIOGRAPHY

- <sup>1</sup> Haggard W D Nashville Journal of Medicine and Surgery 1898, vol lxxviii, No 3
- <sup>2</sup> Edebohls American Journal of Medical Sciences, 1895, vol clx p 650
- <sup>3</sup> Elsberg, Chas Personal Communication
- <sup>4</sup> Lilienthal, H Medical News vol lxxviii, p 1020
- <sup>5</sup> Monks and Blake Boston Medical and Surgical Journal, Nov 20, 1902, vol cxcvii, No 22, p 581
- <sup>6</sup> Deaver, J B ANNALS OF SURGERY, vol lxxx, No 1, p 56
- <sup>7</sup> Scelig, M G ANNALS OF SURGERY, Nov, 1904
- <sup>8</sup> Ochsner, A J Personal Communication
- <sup>9</sup> Quoted by Scelig
- <sup>10</sup> Ridel Centrblatt f Cherg, No 51, 1903

# HERNIA OF THE BLADDER<sup>1</sup>

A BRIEF REVIEW OF THE LITERATURE WITH A CASE REPORT AND A  
SUGGESTION OF A POSITIVE METHOD FOR PRE-OPERATIVE DIAGNOSIS

BY ROBERT EMMETT FARR, M D

AND

CLARENCE W BRUNKOW, M D

OF MINNEAPOLIS, MINN

IN 1919 Watson<sup>1</sup> brought the published cases of bladder hernia up to date. Since that time a number of cases have been reported and it is our purpose, in this communication, to mention some of the recorded cases, some of the theories advanced regarding the etiology of the condition, some points regarding the pathology and treatment, to suggest a means of diagnosing the condition with certainty, and to append a report of a case treated in our own clinic.

That this type of hernia is rather rare is shown by reference to the following papers. The first report<sup>2</sup> is probably that of F. Plater, of Basle, in 1550, the second case by Jean Sala in 1620. Over one hundred years later, in 1752, Verdiei reported twenty cases. Moynihan, in 1890, collected thirty-eight cases, Brunner in 1896, one hundred and eight cases. Moynihan one hundred and twelve in 1900 and Shiell one hundred and thirty-three cases in 1908. Heineck, in 1914, in a review of the literature back to 1896, found one hundred and sixty-four cases recorded and Watson<sup>2</sup> added to this eighteen more, including two of his own in his report of 1919.

Considering the large number of inguinal and femoral herniæ extant, the percentage of bladder hernia is comparatively small. Brunner and Eggenberg found this condition to exist in about 1 per cent of eight thousand seven hundred and eighty-eight cases. The literature shows not only that bladder hernia is infrequent but also that when it exists, surgeons usually fail to make a diagnosis before and sometimes during operation.

*Etiology*—Among the causes mentioned are the following:

*Prevesical Fat*—Verdiei, quoted by Watson in 1752, first called attention to prevesical fat as a factor. This, acting in conjunction with other factors, either congenital or acquired, has been believed by many writers to take part in the causation of bladder hernia. In the case of inguinal hernia the traction of the fatty tissue attached to the bladder wall may draw the latter downward as the extent of the enterocele increases. Oliva<sup>3</sup> believes that inflammation more firmly fixes the fat to the bladder and surrounding structures. Watson cautions that we should be on the lookout for bladder hernia in the recurrent types.

*Sliding Hernia and Weak Abdominal Wall*—Heineck<sup>4</sup> believes that

---

\* Presented in Abstract before the Minnesota Academy of Medicine, October, 1924

bladder hernia is most often associated with the so-called sliding hernia and most writers agree that the condition is associated with congenital or acquired weakness of the abdominal wall

*Age and Sex*—Baker<sup>7</sup> quotes Caley, who found that they occur most commonly in the male between fifty and sixty and in the female between thirty and forty. Oliva likewise agrees that bladder hernia is associated with old age and states that there are only sixteen cases of bladder hernia in children reported in the literature. They are uncommon before the age of forty and pregnancy is a factor that may explain the fact that they appear earlier in women. Trauma may cause a weakened abdominal wall to give way. The history in our case is suggestive of a sudden increase in intra-abdominal pressure. Changes within the bladder itself may be instrumental in helping to produce bladder hernia. Any bladder obstruction with marked distention places an additional strain upon the abdominal wall or an atonic bladder with marked flaccidity offers the chance of its wall or a diverticulum to be pushed through a hernial ring.

From the above it is evident that the etiology of bladder hernia is more or less theoretical and attempts to explain its formation are based upon the factors mentioned, *viz*, prevesical fat, a weakened abdominal wall, either congenital (as considered the case with most inguinal herniæ) or acquired (as following the sudden change in intra-abdominal pressure), abdominal trauma, marked distention of an obstructed bladder, bladder diverticulum or flaccidity, pregnancy, obesity, old age or debilitating disease.

*Pathology*—The bladder hernia may be inguinal (direct or indirect) or appear in the femoral canal. The femoral type is most frequently found in women.

Most bladder herniæ are not true herniæ in the sense that they are found in a peritoneal sac, but are false herniæ. Jaboulaz and Villard are credited with classifying them as intra-, extra- and para-peritoneal depending upon whether the bladder is within, outside or beside the peritoneum. In order of their frequency para-peritoneal comes first, then intra-peritoneal and last extra-peritoneal. Aside from the locations and types of herniæ, the pathological findings in relation to the sac, cord, fat and bladder will be briefly considered.

The difficulty or impossibility of finding a true hernial sac often presents and this is easily understood when we recall the relation of the bladder to the peritoneum. If a true sac is present, it will be found that the neck of the true peritoneal pouch directs its pedicle *away* from the midline, whereas, if the sac really consists of the bladder or a bladder diverticulum its pedicle is directed *toward* the midline. The spermatic cord usually lies to the outer side of the sac, may be spread over, behind or below and external to the sac according to Heinck. Excessive fat in the inguinal canal and the prevesical lipoma already considered as a possible etiological factor, are considered also pathological findings of bladder hernia. The pathologic findings in the bladder itself are not constant. The bladder wall may be

thick or thin. The herniated portion may be a part of the bladder proper, as in our case, or it may be a diverticulum. According to Baker calculi may be present in either case.

*Symptoms*—The patient generally comes to the physician because he notices a bulging or "rupture" in the inguinal, or in the case of a woman, in the femoral region. This bulging may of course, consist either of the bladder or a bladder diverticulum, excessive prevesical fat, an intestinal or omental hernia or a combination of these. In addition hydrocele and varicocele, inflammatory glands and new growths must be kept in mind. The differential diagnosis will be considered later.

A second important symptom is the effect of urination upon the swelling. Heneck and Watson have used the term "two-step" urination in which the patient first voids the urine contained in the bladder proper and following this is able to pass the urine which has accumulated in the portion contained in the hernia. In our own case the "two-step" urination was not a prominent feature but the patient stated that he knew that the bulging was closely related to urination as he always found that emptying the bladder was not satisfactory unless he "lifted up and pushed in on his rupture while voiding." This brings up another important symptom, namely, that the swelling decreases in size with each urination but soon reappears.

Pain on urination may be present, but in our case this symptom did not present until shortly before the patient consulted us and was then caused by a secondary cystitis with marked frequency as well. Baker's case however showed severe constant pain from a purely mechanical cause as that found in any strangulation.

*Diagnosis*—In arriving at a pre-operative diagnosis of bladder hernia, the history of the symptoms just mentioned is very important, as stressed by Baker, who was able to get a very definite urologic history in his case after the operation, but in view of the emergency of the case, thinking it to be the usual omental or intestinal strangulation he neglected this before the operation. The physical findings of a bladder hernia on palpation are much like those of the usual hernia, namely a bulging mass but Guterbork is given credit by Watson for the point that on rectal examination the normal bulging of the distended bladder is missing in the case of a bladder hernia. We were not familiar with this point when our case was examined and it was, therefore, not noted when the prostate was palpated. In men a rectal examination should always be made to determine if there is an enlargement of the prostate giving bladder obstruction with overdistention.

The next step in making the physical examination should be taking note of the effect of urination on the size of the hernia. If it decreases in size a portion of the bladder is quite sure to be present in the sac. Otherwise the possibility of a calculus as previously mentioned must still be considered. Another diagnostic point mentioned by Heneck that a bladder hernia, after reduction still presents a "doughy mass," which is probably the prevesical fat. Watson states that a non-reducible hernia should suggest a bladder

## HERNIA OF THE BLADDER

hernia, and as previously mentioned, a direct or recurrent hernia should also place the examiner on guard. Oliva states that, on inspection, the swelling of a bladder hernia is reddish-gray in color and that worm-like contractions of the bladder muscle should be looked for.

The mechanical tests which should be employed to establish a pre-operative diagnosis of bladder hernia are, in the most part, simple. To rule out hydrocele, it is only necessary to trans-illuminate, and if the mass is not translucent it is not a simple hydrocele. Cystic fluid can also be differentiated from urine by a diagnostic aspiration or paracentesis according to Watson. The possibility of the needle puncturing the intestine must be kept constantly in mind. As has been stated, a non-translucent mass may be a varicocele, prevesical fat, an omental or intestinal hernia, inflammatory glands or a new growth as well as bladder. A varicocele should, on palpation, give the typical cuciform venous outlines and offer no particular difficulty in diagnosis. The other conditions mentioned must still be eliminated. A simple but definite means of doing this is to pass a sound, as suggested by practically all of the previously mentioned writers. If the tip of the sound is felt within the swelling, it is safe to conclude that a portion of the bladder is present in the hernia. Another simple procedure is to pass a urethral catheter. If a decrease in the size of the swelling follows the flow of urine, the bladder must participate in the formation of the hernia. Then, by injecting fluid or air, the reverse phenomena may be demonstrated. This has been suggested previously by others and was repeated in our case, although we had in mind a further refinement in diagnosis which will be discussed later. The above procedure may be followed by a cystoscopic examination, preferably under sacral anaesthesia, which completes the study of the prostate and allows an examination of the bladder for the purpose of identifying a diverticulum or pouching of the bladder wall. In our own case this was done, but a satisfactory view of the bladder was not obtained on account of the cloudiness of the urine due to the presence of a large amount of pus and sediment and the large portion of the bladder involved in the hernia. The ridge separating the bladder proper from the portion participating in the hernia had the appearance of the vesical projection of an enlarged prostate.

*The X-ray in Diagnosis*—Valuable information may be obtained by means of the X-ray in conjunction with catheterization following the injection of air, iodide or bromide solutions. In our case, after the urine was removed from the bladder, air was injected and an antero-posterior X-ray view in the horizontal position established the diagnosis (Fig 1), which was confirmed by expressing the air and injecting several ounces of sodium bromide solution, after which another cystogram was made (Fig 2). Sgalitzer<sup>14</sup> had, unknown to us, used potassium iodide (seven per cent) with the patient sitting on the plate bending slightly backward, and in this way had shown the projection of the bladder wall into the inguinal ring. He should be given priority in the use of this method.

*Complications*—The complications of bladder hernia may either call for



immediate operation or postponement of the same, depending upon the circumstances. Among the complications which may commonly present are strangulation, calculi, cystitis, or an omental or intestinal inguinal hernia. Strangulation, must be treated immediately, as in every strangulation, but a correct pre-operative diagnosis is desirable, as it may serve to prevent accidental injury to the bladder with its post-operative complications. The presence of calculi within the hernia will be discussed under treatment and usually demands that the bladder be opened and that the patient be brought into the best possible condition as in any other bladder calculus operation.

A complication not frequently mentioned is cystitis. This was found in our case and we believe that, in the absence of strangulation, the cystitis should first be alleviated by crowding fluids, lavage and antiseptic instillations before surgical repair is attempted.

*Treatment*—Obviously the treatment of a bladder hernia is surgical. If complicated by an omental or intestinal hernia, the important points are to secure a competent repair of the abdominal wall, according to Bassini or one of the modifications, and to avoid, if possible, accidental opening of the bladder. An accidental urinary spill into the peritoneum should be especially guarded against and we would suggest that just before operation the bladder be emptied with a catheter, after which an air pump is attached, thus aiding the surgeon in identification of the bladder during operation and thereby preventing soiling. This method has been used by us for many years in all cystostomies, even when the invasion of the peritoneal cavity is not anticipated.

If a definite bladder diverticulum is found to be present it should be resected according to Odasso<sup>7</sup> and others and the bladder closed in layers. Opening the bladder may also be found necessary for the purpose of removing a calculus. In all such cases a drain should be used in the wound. In our case the bladder was replaced without opening it.

The question of using an in-lying catheter is not settled. Oliva, however, advocates it routinely in all cases that need bladder suture. Watson advocates bladder irrigations and instillations of argyrol every four hours in such cases. He also makes the point that the bladder should be anchored, if injured so that possible drainage can be controlled and directed.

*Prognosis*—Very few statistics are found with regard to the prognosis of bladder hernia. Watson believes that bladder trauma is the most important factor and that where bladder wounds occur the mortality is from fifteen to twenty per cent. Of course many other factors exert an influence, especially cystitis or infections elsewhere, and old age and obesity usually add to the gravity of the case.

**CASE REPORT**—Mr. L., age fifty-nine, married. Consulted us May 30, 1924 complaining of the following symptoms. He had had a hernia in the left inguinal region for twenty-six years. About ten months ago this hernia apparently disappeared and gave no trouble for about nine months. Two or three weeks ago the hernia returned following a jar produced by the patient slipping upon a banana peeling. For the past six or seven days there had been a good deal of pain in the left inguinal region accompanied by frequent and burning micturition the patient passing but a small amount of urine at a time.

## HERNIA OF THE BLADDER

His family physician told him that his urine contained pus. The patient had attempted to retain the hernia by means of a truss but had been unsuccessful. His general health had been good, but he was inclined to obesity—weight about two hundred pounds. His physical examination was negative, excepting for some gingivitis and decayed teeth, blood-pressure 140/80, some tenderness in the right upper quadrant and an indefinite history of chronic indigestion. Examination of the lower abdomen, which was pendulous, showed what appeared to be a left oblique inguinal scrotal hernia, the protruding mass being approximately the size of an orange. The mass fluctuated and disappeared when

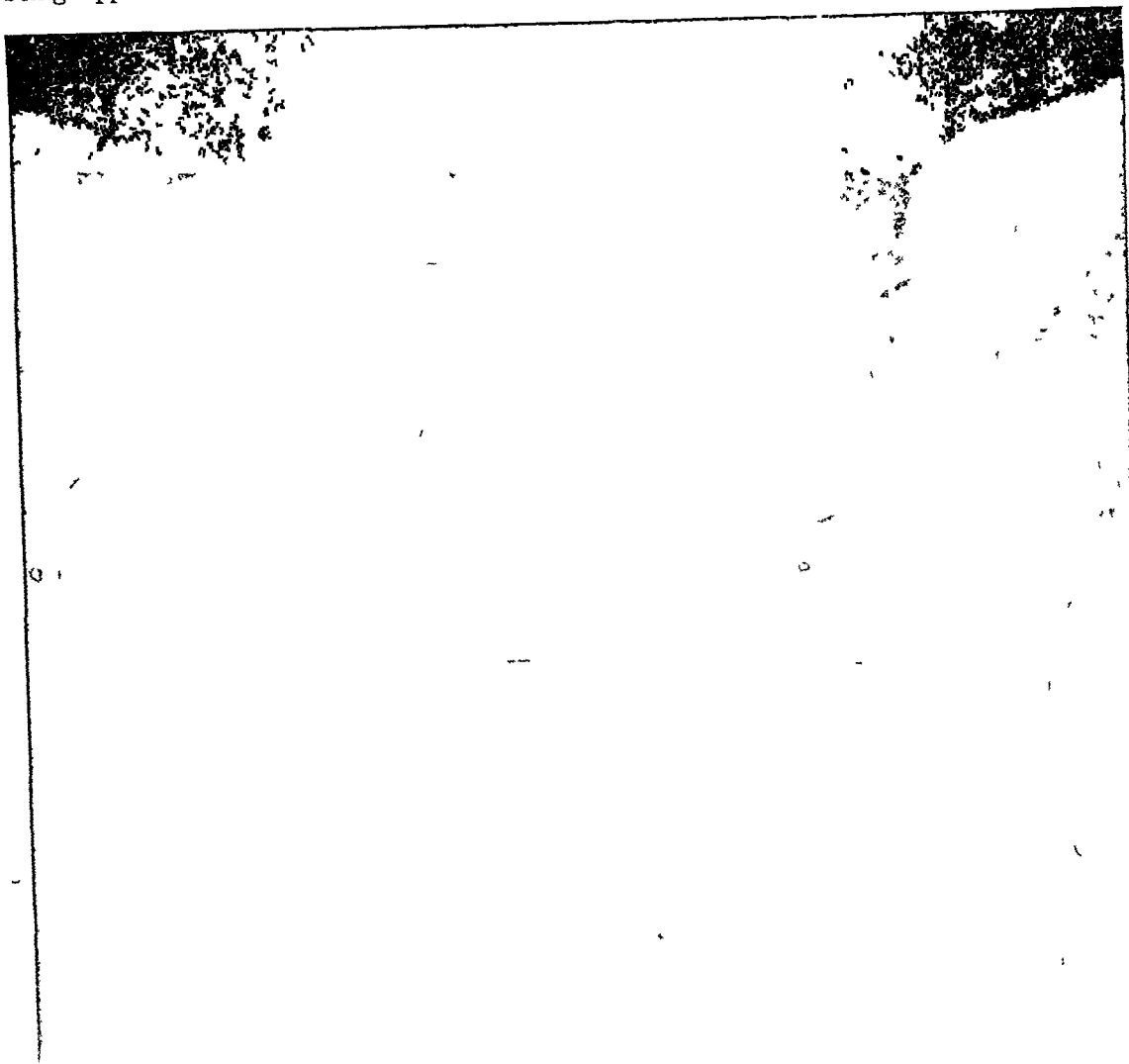


FIG 1 —Hernia of the bladder. Pneumocystogram showing bladder dilated with air and about one-third of its wall occupying the inguinal canal.

the patient assumed the recumbent position, the hernia ring easily admitting three fingers. Manipulation of the hernial contents caused vesical tenesmus. The urine showed a specific gravity of 1020, a fair trace of albumen, a few red and many pus cells. Two days later, June 1, the patient entered St. Mary's Hospital for investigation. On June 2, he was asked to empty the bladder as completely as possible, and then the following investigation was made after introducing 70 c.c. of 1 per cent novocain-adrenalin solution into the sacral canal. A soft rubber catheter was introduced through the urethra and 75 c.c. of cloudy residual urine was withdrawn. No change was noted in the appearance of the hernia as the distended hernial sac had disappeared with the patient in the recumbent position, as noted above. The bladder was then distended with air and the reappearance of the hernia was noted, although its dimensions were not as great as when the patient was

standing. A pneumocystogram was then made with the patient in the vertical position (Fig 1). This conclusively demonstrated that a large part of the bladder participated in the scrotal portion of the hernia. The air was then replaced by a 15 per cent solution of sodium bromide and the cystogram (Fig 2) was made. The cystoscope was then introduced and the presence of an acute cystitis ascertained. The ridge separating the

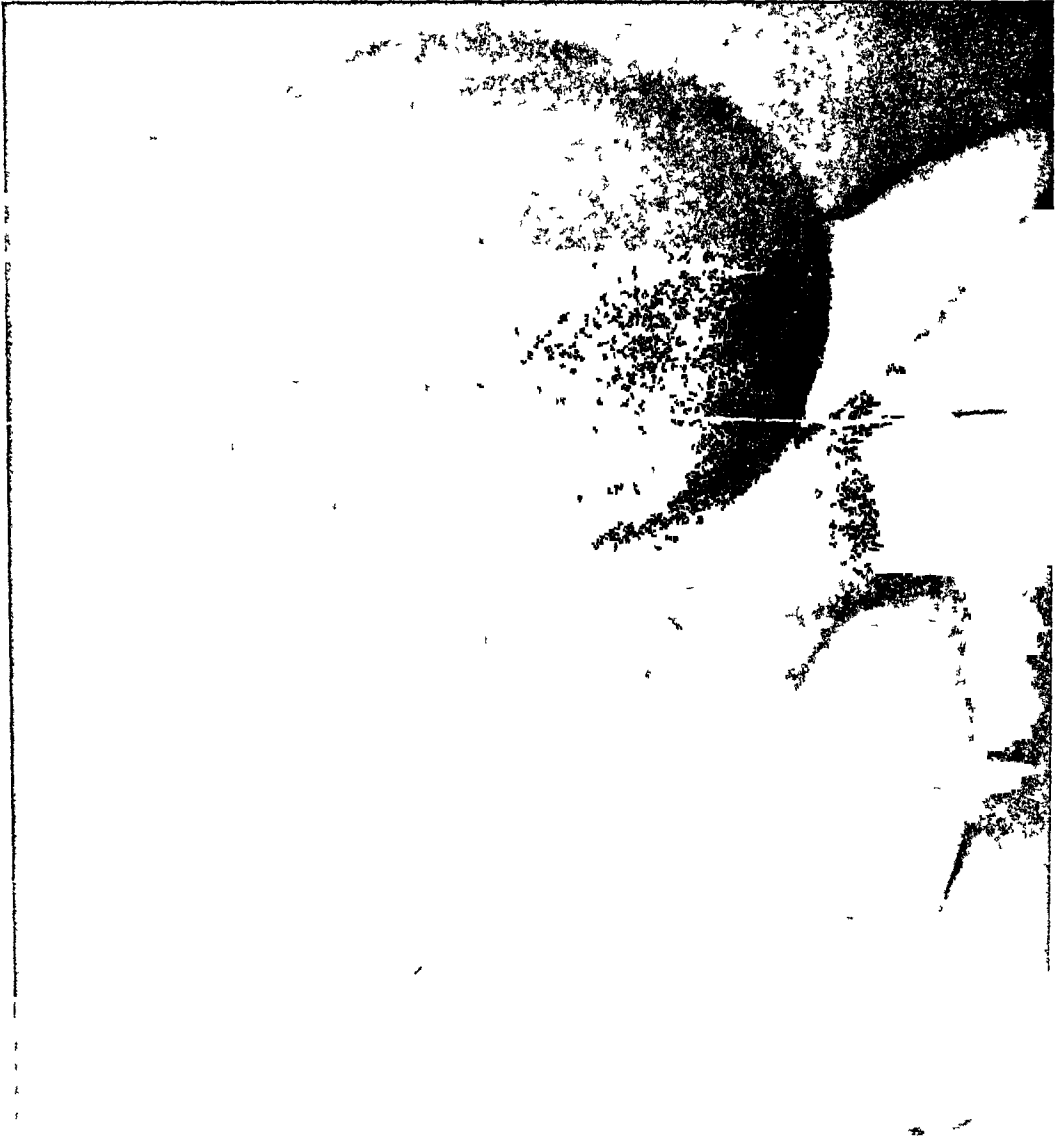


FIG 2—Hernia of the bladder. Radiogram showing bladder filled with 15 per cent sodium bromide solution. About one-third of the bladder occupies the inguinal canal.

herniated portion from the remainder of the bladder had the appearance of the projecting lobe of a large prostate. Following this the cystitis was treated with irrigations of boracic acid solution and instillations of mercurochrome until practically all urinary symptoms had abated. After leaving the hospital on account of the demands of business the patient developed an acute bronchitis, followed by an attack of acute cholecystitis, complicated by jaundice, for which he entered the hospital on July 3. His gall-bladder condition rapidly cleared up and on July 17, after his condition had returned to normal,

## HERNIA OF THE BLADDER

the hernia operation was performed Under local anæsthesia the hernial sac was exposed and opened immediately after identification of the veins and vas The exposure of the peritoneal surface of the bladder, combined with the information gained before the operation, contributed greatly to the facility with which the herniated portion of the bladder was dissected from its scrotal bed With the patient in the Trendelenberg position and tilted to the right, a negative intra-abdominal pressure obtained, and the peritoneal sac, which was voluminous, was found to contain no attached viscera The

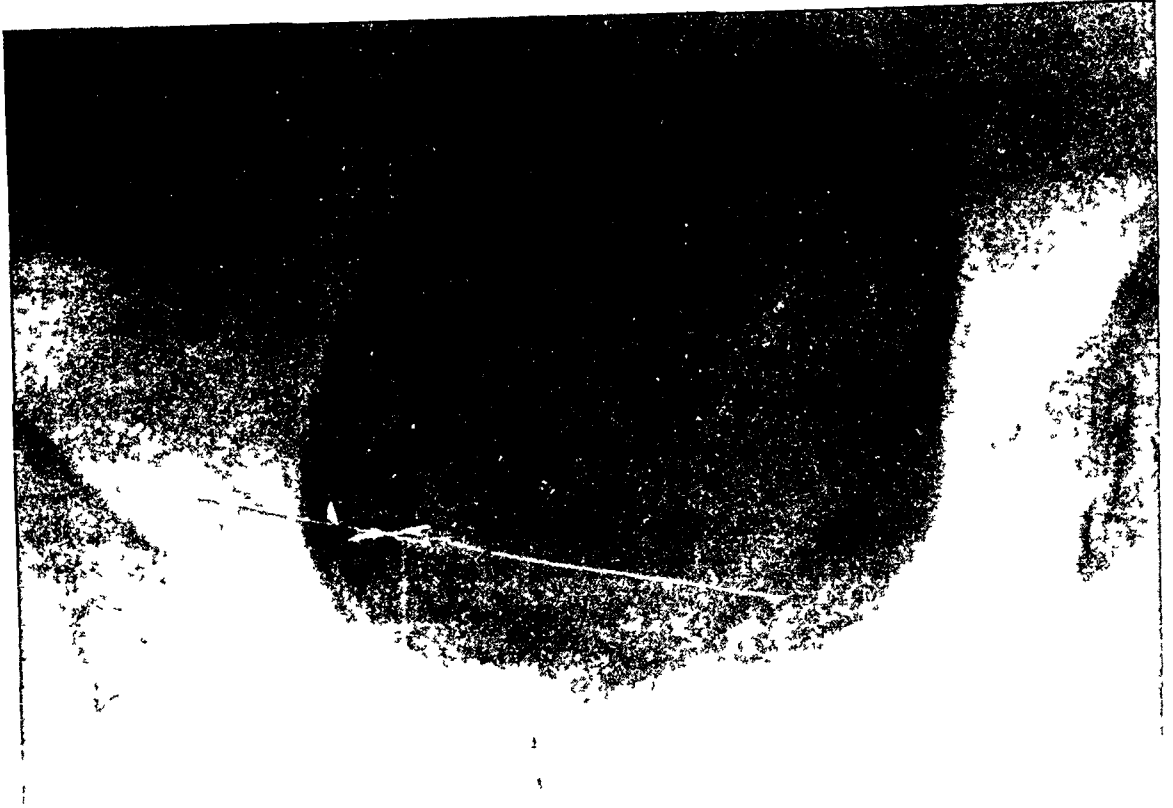


FIG 3 —Hernia of the bladder After operation Bladder partially distended with 15 per cent sodium bromide solution Showing that organ has assumed its normal contour

sac was excised and closed in the usual manner A large mass of varicose veins excised and the fascial planes united after the method of Bassini and Andrews, using chromic gut The herniated portion of the bladder after its release gravitated into its normal position in the pelvis The laxity of the abdominal wall and the absence of red muscular tissue allowed ample opportunity for broad overlapping of the fascial planes\* Special precautions were taken to unite the tissues near the mesial line The patient made an uninterrupted recovery, has had no return of his bladder symptoms, and the cystogram (Fig 3) shows that the bladder returned to its normal position and assumed its natural contour, thus proving quite satisfactorily that, in this case, we were not dealing with a bladder diverticulum Although this patient's abdomen was fat, there was a comparatively small amount of fat present in the hernial mass These factors quite effectually

eliminate prevesical fat, bladder diverticulum and sliding hernia from the etiology of this case. Our impression is that relaxation of the abdominal wall or a possible congenital deformity, or both, are to be considered among the most important etiological factors.

# CONCLUSIONS

In all inguinal and femoral herniæ, especially in people past middle life, the possibility of the involvement of the bladder should be kept in mind.

In any case a positive diagnosis can be made by means of the X-ray as outlined above.

# BIBLIOGRAPHY

- <sup>1</sup>Watson, L. F. Etiology of Hernia of the Bladder. *Am J Surg*, vol. XXXVI, pp. 55-56, 1922.
- <sup>2</sup>Watson, L. F. Bladder Hernia—Report of Two Cases. *Ill Med J*.
- <sup>3</sup>Oliva, C. Hernia of Bladder in Children. *Arch Ital di chir*, vol. VI, pp. 533, 564, Jan., 1923.
- <sup>4</sup>Henneck, A. P. Hernia of Urinary Bladder. *W. Virginia M. J.*, vol. XX, p. 374, April, 1921.
- <sup>5</sup>Baker, J. N. Hernia of Bladder. *ANNALS OF SURGERY*, vol. LXV, pp. 615-619, May, 1922.
- <sup>6</sup>Sgalitzer, M. Change of Shape of Bladder with Open Hernial Passage, as Shown by X-ray. *Mitt A. D. Grenzgeb. d. Med. u. chir.*, vol. XXXIV, p. 132, 1921, Jena.
- Odasso, A. Hernia of Bladder Diverticulum. *Policlinico (sez. chir.)*, vol. XXXI, pp. 211-222.

# GRANULOMA INGUINALE

By R. RUSSELL BEST, M.D.

OF OMAHA, NEB.

*History*—Granuloma inguinale as a clinical entity was first described by Conyers and Daniels in 1896. A few years previously, 1882, McLeod, of India, described a serpiginous ulceration of the groin. In our country, it was described by Guindon in 1912. During the last five years there have been not infrequent reports of cases of ulcerating granuloma of the pudenda. Driver, in 1923, reported eight cases out of 485 genital lesions over a period of two years.

The disease is now apparently more endemic than sporadic, especially in the negro race, unless it is merely that our diagnostic ability is becoming greater.

## *Etiology*

—The bacterial agent most commonly accepted as the etiological factor is the small



FIG. 1.—Lesion before treatment

rod or coccus-like body of *Donovans* which lies singly or in groups in mononuclear cells obtained by scraping the sore. It takes the ordinary stains such as Gram's but the Giemsa stain is necessary to demonstrate the capsule. This organism has not been found in all cases. However, it was found in this case. Some writers believe its presence merely a secondary characteristic and not a cause. Wise advanced the theory of a spirochaetal origin, but it seems to have lost favor. Syphilis as a cause has definitely been ruled out.

*Pathology*—For the histopathology the writer refers to the studies of Conyers and Daniels, Galloway, Claassen, or Goodman. In general, there is a marked round-cell infiltration, increased vascularity, tissue destruction with no tendency to caseation, suppuration or giant-cell formation.

*Diagnosis*—Granuloma inguinale usually begins as a papule which soon undergoes ulcerative changes, resulting in a sharply outlined, shiny-red granular ulceration, serpiginous in character and bleeding easily. Cicatrizing islands form within the mass of granulation tissue but soon break down, due to the development of new nodules. The disease spreads by auto-inoculation and

peripheral extension, the secretions usually following the dependent skin folds toward the anus and laterally along the gluteal folds. In its upward extension it follows the inguinal fold. The absence of adenopathy seems to be a striking characteristic. However, there is frequently considerable blocking of lymph channels leading to a pseudo-elephantiasis of penis or vulva. The surrounding induration of the ulcer is rather superficial in character and of soft cartilaginous consistency. The patient complains more of burning and itching rather than of sharp pain. The general condition of this patient even over a period of eight years does not seem to have become cachectic. The extending ulceration with resulting cicatrization may lead to stricture of the anus, rectum, urethra, or vagina. In a condition similar to the fore-



FIG. 2.—Lesion after treatment with tartar emetic. Entirely healed.

going especially if there is a history of chronicity and a failure to respond to anti-luetic or other ordinary methods of treatment granulo-  
ma inguinale should be strongly suspected.

#### *Differential Diagnosis* —Ulcerating lesions of the

pu-  
denda are usually first considered as luetic. From chancre, it is differentiated by its definite sclerosed border and friable granulating cicatrizing base. The chancre, although indurated, is sharply punched out and has a rather flat base. History of chronicity and lack of adenopathy also favor ulcerating granuloma.

From condyloma lata, it is differentiated by its granular appearance, color, and ulceration. From gumma it is differentiated by the slow advance, superficial character, and vascularity. At times serology or failure to respond to treatment may help in the diagnosis.

In chancroid, there is an acute inflammation with painful inguinal adenopathy and no sclerosing border.

From tuberculosis, by the organism of Koch, tuberculin reaction, animal inoculation, and other signs of tuberculosis.

Epithelioma and carcinoma are common diagnoses for ulcerating granuloma (such as this case) and superficially it does resemble it with the indurating edges and friable granulating base. The presence of an ulceration with scales or crusts and the histological picture would differentiate the two con-

## GRANULOMA INGUINALE

ditions. Clinically the history, age of patient, absence of glandular enlargement, metastasis, cachexia and effect of treatment would exclude malignant disease.

Esthiomene (Graves) is distinguished by the extreme inflammation, and ulcerating of the vulva with superficial sloughing and purulent discharge.

*Treatment*—This type of lesion from the reports of previous writers and from the behavior of this case, does not respond to ordinary antiseptics, anti-syphilitic treatment, surgery, X-ray or radium. In 1906, Mensil and Nicolle first introduced antimony and potassium salts in treatment of diseases of protozoal origin. In 1913, Aiagoo and Vianna in Brazil were the first to treat granuloma inguinale with these salts. This drug is apparently selective and in the great majority of cases rapid healing takes place. The best results are obtained by intravenous treatments, the drug being obtained in ampules of 1 per cent solution. In this case 1 c.c. of a 1 per cent solution was diluted with 5 c.c. of sterile distilled water, treatments being given every three or four days and dosage increased by 1 c.c. until 5 c.c. diluted with 5 c.c. sterile distilled water was being given at one dose. Within one week there was improvement and at the end of four weeks the lesion was entirely healed. The local treatment may be limited to a wash. A urinary antiseptic by mouth, because of an accompanying genito-urinary infection especially in females, is probably advisable.

*CASE REPORT*—S. I., negress, age thirty-six, married, first at fourteen divorced, married and divorced again, never lived south of Kansas border, both husbands from Oklahoma. Eight years ago, in 1916, a small ulcer appeared on the vulva. A diagnosis of a syphilitic infection was made by her family doctor, and under treatment the lesion became worse. Failing to respond to treatment, a diagnosis of cancer was made. She was given douches and an ointment and failing to find relief changed doctors. Again it was diagnosed as syphilis and failing to respond to treatment was again called cancer. She was told that an operation would be futile and was given narcotics ad-lib and a local wash. In 1920, with the lesion gradually progressing, she went to another doctor who advised X-ray and radium treatment. At this time she was in the hospital for five months. She was then sent to the hospital again where the labia minora were removed because of pain and swelling and a few glands removed from the left inguinal region. At this time, she developed a sore on the left thigh and was told that she was absolutely incurable and again discharged with narcotics ad-lib. She then began losing weight and appetite and was practically bedridden. In November, 1924, she came under my observation eight years after onset. There was extensive ulcerating granuloma of the perineum with islands of cicatricial tissue (Fig. 1). The ulceration had invaded the vagina and rectum and vaginal examination revealed a soft cartilaginous induration throughout the perineum. It did not have the consistency of cancer nor was there the invasion and adenopathy that goes with it. The labia minora were absent. There was a similar ulcer, the size of a silver dollar, on the left thigh. The general condition was only fair, some loss of weight. The Wassermann reaction was negative.

The lesion was kept clean with weak boric acid solution for several days and then after omitting the wash one day, smears were taken. From five smears, only one slide showed a few mononuclear cells with intracellular coccus-like bodies. No capsule was demonstrated. Treatment, as outlined above, was then instituted.

*Progress*—Within one week there was improvement and at the end of four weeks the lesion was entirely healed.



*Summary*—Summarizing, we may say 1 The disease is not rare in the temperate zone 2 The intravenous administration of tartar emetic constitutes a specific form of treatment in a large majority of cases

# BIBLIOGRAPHY

- <sup>1</sup> Claassen, H L Ohio St M J, Oct, 1922, p 685
- <sup>2</sup> Castellani Treatment of Certain Diseases of Protozoal Origin by Tartar Emetic Brit Med Jour, vol 11, p 552 1916
- <sup>3</sup> Campbell, Meredith J A M A March 5, 1921 p 648
- <sup>4</sup> Driver, J R J A M A, Sept 9 1922, p 867
- Daniels Remarks on Ulcerating Granuloma of Pudenda Brit Jour of Derm, vol 18, p 352, 1897
- <sup>5</sup> Ehrlich Surg Gyn & Obst, Jan 1925, p 107
- Galloway Ulcerating Granuloma Brit Jour of Derm, vol 18 p 133, 1897
- <sup>6</sup> Goodman, Herman Archiver of Dermatology and Syphilology Feb, 1920, p 151
- <sup>7</sup> Low and Newman Case of Ulcerating Granuloma Successfully Treated by Intravenous Injection of Antimony Brit Med Jour, vol 11, p 387, 1916
- <sup>8</sup> Lynch, Kenneth J A M A, Sept 17, 1921, p 925
- <sup>9</sup> MacLennan Memorandum on Observations of Spirochete in Yaws and Granuloma Pudenda Brit Med Jour vol 11 p 995, 1906
- <sup>10</sup> Maitland Etiology of Granuloma Pudenda Brit Med Jour, vol 1, p 1463 1906
- <sup>11</sup> Randall, Small and Belk Granuloma Inguinale Surg Gyn & Obst, June, 1922, p 717
- <sup>12</sup> Randall Am J Urol June 1923, p 491
- <sup>13</sup> Reed and Wolf New Orleans M & S J July, 1921
- <sup>14</sup> Summers and Frost J A M A, May 8 1920 p 1304
- <sup>15</sup> Wernberg Am J Urol, June 1923, p 505
- <sup>16</sup> Wise Notes on Etiology of Granuloma Pudenda Brit Med Jour, vol 1, p 1274, 1906

# CYSTS OF THE ILIO-PSOAS BURSA

BY WILLIS D GATCH, M D

AND

W T GREEN, M D

OF INDIANAPOLIS, IND

FROM THE LABORATORY OF SURGICAL PATHOLOGY OF THE INDIANA UNIVERSITY SCHOOL OF MEDICINE

THE ilio-psoas bursa is situated beneath the musculo-tendinous portion of the ilio-psoas muscle, where it bends over the edge of the pelvis and the capsule of the hip-joint. It is said to be the largest synovial bursa normally present in the body. Its anatomical relations have been carefully studied by Durville, Lund, and others, though these writers differ somewhat as to its extent. Durville states that its upper limit is not above Poupait's ligament, whereas Lund states that, in a great number of cases, it extends upwards into the iliac fossa. Both writers are agreed that its inferior border is in the neighborhood of the lesser trochanter of the femur, and that its lateral extent is approximately from the ileo-pectineal eminence medially to the anterior inferior spine of the ileum, laterally.

The portion of the capsule of the hip-joint lying between the ilio-femoral ligament (Y ligament) and the pubo-capsular ligament is very thin. At this spot the bursa is in almost immediate relation with the synovial membrane of the hip-joint. In some cases the membrane separating them is imperfect and a communication is established between the bursa and the hip-joint. It would seem that such communication is not unusual, particularly in the adult of middle age or past. Perhaps as stated by Durville, trauma and friction tends to establish the communication.

Cysts, as well as inflammatory conditions of the ilio-psoas bursa, are probably of more common occurrence than the rather infrequent reports of them in the literature would seem to indicate. We have been able to find reports by only two American writers, Lund and Cullen. As far as we are able to determine, Joly first described cystic lesions of this bursa in 1847. Durville writing in 1895 published the first comprehensive article. This paper, together with the work of Zuelzer, are the classical papers on the subject. We have been able to collect 32 cases from the literature, of these 9 were inflammatory (including tuberculous) lesions, and 23 were simple cystic tumors.

The purpose of this paper is to add a new case to the literature and to summarize the clinical data on affections of the ilio-psoas bursa.

*Clinical History*—Mrs W H S was referred by Dr Leslie Lingeman, of Noblesville, Indiana, for a tumor of the right groin.

The patient was sixty years of age, and had never been of rugged health. Her father, a brother, and a sister had died of tuberculosis. For the past six or seven years

---

\* Read before the Western Surgical Association, December, 1924

she had complained of aching pains in her limbs (including the hip-joint) and back. She also has had occasional spells of numbness and weakness in the legs which have caused her to fall to the floor.

She had noticed the tumor of the groin for the first time two months before the examination. There had been an entire absence of pain, disability or discomfort traceable to the tumor.

The patient was a tall, thin, rather anemic-appearing woman. A general physical examination revealed nothing of importance. Temperature, normal. Blood-pressure, 180/90. Complement fixations for syphilis and tuberculosis were negative.

In the right groin was an ovoid tumor about the size of a hen's egg directly below the middle of Poupart's ligament, its long axis parallel to the ligament. It had a definite edge. Its contour was smooth and regular. The skin over it was unchanged in appearance. Over the internal aspect of the tumor could be seen the femoral artery which was pushed forward by the mass. No fluctuation could be detected. The tumor did not change in shape or position on any movement of the thigh, and apparently was firmly attached to the deep structures. There was no enlargement of the inguinal glands and no detectable interference in the circulation of the leg. Deep palpation above Poupart's ligament revealed nothing abnormal. The patient walked without pain or limp. There was no bulging on coughing or straining. There was no pulsation. The hip joint seemed normal in every respect. Examination of the spine was negative, as was pelvic examination. There was no evidence of bone disease in either the pelvic bones or vertebrae. Psoas abscess could certainly be excluded, likewise hernia, aneurism or enlargement of lymphatic glands. The hip-joint was apparently normal. The tumor was regarded as probably neoplastic, though its smooth contour and the lack of attachment to the skin or interference with the circulation of the limb made it seem likely that the tumor was not malignant.

In light of our present knowledge, a probable diagnosis of cyst of the ilio-psoas bursa should certainly have been made.

*Operation*—A skin incision was made below and parallel to Poupart's ligament directly over the most prominent part of the tumor. The fascia lata was easily stripped from the mass. The anterior crural nerve was carefully isolated and retracted medially. On clearing the surface of the tumor of overlying fat and areolar tissue fluctuation was detectable. It was then perfectly evident that we were dealing with a cyst. It was aspirated and about 40 cc of a gelatinous material of about the consistency of thin apple jelly was withdrawn. The cyst was now opened and the remainder of its contents evacuated. The wall was tough and fibrous with an inner surface smooth and mucoid. The inner surface and contents were similar in every respect to those of ordinary ganglion.

The cyst wall was completely excised. It was found to be attached on its posterior surface over an area the size of a nickel to the pubic bone and capsule of the hip-joint. In freeing the wall, a secondary very small cyst, more deeply placed beneath the ilio-psoas tendon, was opened. Although the cysts did not communicate one with another, it was noted that there was a funnel-like dimple at the very bottom of the larger cyst, extending towards the smaller, which gave the idea that they might at one time have communicated.

The wound was closed in layers and without drainage. The patient made an uneventful recovery.

Microscopically the cyst wall was demonstrated to consist of a dense hyalinized fibrous tissue in which were sparse areas of round-cell infiltration. The free edge exhibited a condensation of fibrous tissue but no demonstrable lining mesothelium.

*General Discussion*—We can find in the literature but two other cases of cyst of the ilio-psoas bursa in women, those of Heineke and Pisano. The other 21 cases all occurred in men.

## CYSTS OF THE ILIO-PSOAS BURSA

For all practical purposes we may divide enlargements of the ilio-psoas bursa on the basis of etiology into four classes (1) pyogenic, (2) tuberculous, (3) syphilitic, and (4) simple chronic bursitis or cystic tumor

Although this paper is concerned with the fourth type, it is not amiss to mention briefly the first three types

Pyogenic affections of the bursa are either primary in the bursa or secondary to affections of the hip-joint Gonorrheal and typhoid bursitis, as well as bursitis due to the ordinary pyogenic organisms, have been reported The findings are the general and local symptoms of a pyogenic infection The local swelling in the groin is an extremely tender fluctuant mass with all the classical findings of acute inflammation Movement at the joint is extremely painful Not infrequently there may be circulatory disturbances arising from the close proximity of the femoral vein to the inflamed bursa Thrombosis of the vein has been described Even in those cases where there is no communication between the bursa and the joint cavity, there is but a thin sheet of tissue between them, so that a pyogenic infection of the one is likely to involve the other For this reason ilio-psoas bursitis demands prompt surgical attention

Tuberculosis of the bursa may likewise be primary in the bursa or secondary to disease of the hip As in tuberculous bursitis elsewhere, it may be either caseous in form or of the "rice-body" type

Churchman, in a very complete and exhaustive article, has reviewed the subject of syphilitic disease of synovial bursæ He tabulated 28 cases, none of them, however, of the ilio-psoas bursa The syphilitic bursitis may take the form of a simple hygroma (this type is particularly seen in the secondary stage), or it may be of either a gummatous, ulcerative, or fungous form in the tertiary stage The content of the simple hygroma form he describes as being "a yellowish, viscid, cloudy coagulable fluid" This description applies to the type of material seen in the ordinary simple cyst of the ilio-psoas bursa

Characteristics of syphilitic bursitis, he points out, are (1) Previous history, or evidences of syphilis (2) Slow and chronic course (3) Absence of much pain or functional disability (4) Symmetry of the involvement (5) Efficiency of specific therapy

Perhaps some of the so-called cases of simple cystic bursitis of unknown origin are syphilitic in nature

The fourth condition, namely cystic tumor of the bursa, to which our case belongs, seems to be largely of traumatic origin Many of the collected cases have a definite history of trauma It is further to be noted that the condition is usually seen in men who are accustomed to doing heavy labor However as pointed out by Duville, the exact relation between trauma and the condition is not so directly traced as in the chronic bursitis of the superficial bursæ, as for example, in housemaid's knee It is conceivable that the constant friction from the overlying tendon traumatizes the bursa and leads to a simple synovitis with an excessive formation of synovial fluid This leads to distention of the bursa which may extend in various directions

Rheumatism (not acute) involving the hip-joint seems to be the other big etiological factor. In this group of cases in which the disease of the hip-joint seems to be primary, seemingly without exception there exists (or has existed) a communication between the bursa and the hip-joint. Perhaps as W. Morratt Baker describes as occurring in the knee, the increased intra-articular pressure promotes the formation of diverticuli of the synovial sac of the joint and tends to produce a communication between the joint cavity and the bursa even if such has not previously existed.

A slow insidious onset with vague pain and some functional disturbance is the usual history of simple cystic tumor of the ilio-psoas bursa. Occasionally, however, the presence of the tumor mass is the presenting and only symptom. At the onset the pain is usually of a vague and not very distressing character and is more or less inconstant. It may be limited to the region of the thigh immediately below the inguinal ligament, or may irradiate down the medial surface of the thigh and into the knee. Pain in the knee-joint is not at all unusual. Apart from those cases in which the disease of the hip-joint is primary and the involvement of the bursa is secondary (in which the disturbed function is really due to the diseased hip), the functional disturbance at the onset is usually slight. It may consist of a subconscious limp. Occasionally it may be noted that there is a slight tendency to keep the limb in a position of slight flexion and outward rotation.

Sometimes it is a matter of years after the initial symptoms before the tumor mass appears. With the appearance of the tumor mass the symptoms previously noted usually become exaggerated. The pain is likely to be more severe. Functional disturbance is likely to be increased. Occasionally walking is seriously hampered. Duiville mentions a feeling of weakness and uselessness of the limb.

Zuelzer and others have found that the typical attitude of the limb in these cases is one of slight flexion, abduction, and outward rotation. Pain is likely to be increased by the opposite movements.

Usually there is but little interference with mobility at the hip except that incurred by the presence of the tumor mass. Adduction and rotation may be somewhat limited.

The tumor mass is nearly without exception first noted in the upper part of Scarpa's triangle, immediately below the inguinal ligament at about its midpoint. Usually its long axis is more or less parallel to the tendon of the psoas, but it is frequently parallel to Poupert's ligament. It may or may not be fluctuant. Very often fluctuation is absent when the limb is extended, and detectable when it is flexed, as pointed out by Duiville. Sometimes it is unobtainable in either flexion or extension as in our case. Occasionally as noted by Duiville, the tumor is reducible either from its connection with the articular cavity or in the multilocular type of tumor with other more deeply placed loculi.

Rarely as in the case of Kummer there is interference with the circulation of the limb from pressure on the femoral vein.

Durville points out that the pain arising from the tumor is readily explained by the intimate relation of the anterior crural nerve to the tumor mass

The tumor increases in size slowly and may reach the size of an infant's head. With the increased size, the mass may extend in various directions. Frequently it extends upwards into the iliac fossa, and it may, as in Cullen's case, occupy nearly one-half of the pelvis. In Charleston's case the tumor extended down to the knee. Cases have been recorded in which the mass extended posteriorly and presented at the lower margin of the gluteal fold. Occasionally the tumor is multilocular. In Schaeffer's case there were two presenting tumor masses, one in the groin, and the other at the edge of the gluteus maximus. In this case the fluid might be forced from one into the other by digital pressure. Such extreme cases are rare, however, and more usually the projecting tumor mass is single, more or less ovoid in shape, rather sharply outlined, and the size of a hen's egg or slightly larger.

The contents of the cyst is a thick viscous fluid, of high specific gravity, and citrin yellow in color. Occasionally detached cartilaginous bodies have been found in the contents as reported by Cullen and Delbet.

It bears reiteration that the tumor mass may be the only symptom, there being no pain or interference with mobility.

*Treatment*—All writers on this subject are in agreement that the only satisfactory treatment is excision of the cyst. In the present case this was easily accomplished by an incision parallel and just below Poupart's ligament. Lund advises a vertical skin incision with separation of the anterior crural nerve from the femoral artery, and an opening into the cyst by pulling apart the fibres of the ilio-psoas muscle. The approach of course will have to be modified to meet specific conditions.

*Collected Cases of Cystic Tumor of the Ilio-psoas Bursa*—(Not demonstratedly tuberculous or pyogenic) Including the collected cases of Zuelzer and Durville.

CASE I—VELPEAU in the thesis of July. In this case all reducible tumors had been eliminated in the differential diagnosis except cold abscess, an involvement of the articulation, and abscess of the sub-psoas bursa. The good condition of the patient removed the first possibility. The absence of evident affection of the joint, together with the position and general characteristics led to the right diagnosis. Simple puncture was done. The tumor disappeared only to appear again.

CASE II—CHASSAIGNAC. The patient, a laborer, complained of pain in the lumbar region and thigh which would disappear only to return again at irregular intervals. After four or five months a non-fluctuant tumor about the size of a hen's egg appeared underneath Poupart's ligament, between the anterior superior iliac spine and the inferior opening of the inguinal canal. On puncture a limpid yellow fluid resembling synovial fluid was withdrawn. The tumor immediately filled up again. The case was cured by the injection of equal parts water and iodine.

CASE III—NATALIS GUILLOT in Maisonneuve. A man, seventy years of age, who had used crutches for twenty years. Movement at the hip was possible and even easy. The limb was shortened 4 cm. In the inguinal regional was a prominent tumor mass.

lying behind the femoral artery, extending inferiorly about 3 cm below Poupart's ligament, and superiorly for a distance not clearly delimited

At autopsy (the man died of pneumonia) great destruction of the hip was exposed. The head and neck of the femur were destroyed, and the cavity of the acetabulum was filled up with bony tissue. The joint cavity communicated in the region of the lesser trochanter by a small canal with a cystic tumor which was located behind the ilio-psoas and extended upwards into the pelvis for 4 or 5 cm. The capsule of the tumor was composed of dense fibrous tissue. The tumor and the joint cavity were filled with a thick yellow viscous fluid.

**CASE IV—HINKEL** Young woman thirty-four years of age had had for many years a rheumatic involvement of the hip-joint. Examination revealed a fluctuating tumor extending below Poupart's ligament down along the psoas muscle and pushing forwards the femoral vessels. The size of the tumor was decreased on pressure, only to be regained on release of the pressure. Passive motion of the hip was free and without pain. Active motion was limited and weak.

**CASE V—WERNER in Volkmann** The patient was a young man who developed a tumor extending from the lesser trochanter up beneath Poupart's ligament into the pelvis. It contained two litres of clear synovial fluid. The tumor was without any evidences of inflammation.

(It is questionable whether this case should be in this group.)

**CASE VI—CHARLSTON** Charleston describes in a negro fifty years of age, a cystic tumor in the superior and medial aspect of the thigh extending from Poupart's ligament downwards to the region of the knee-joint. It was determined at operation that there was a prolongation upwards into the pelvis.

**CASE VII—SCHAFFER** A man aged forty presented a tumor the size of an infant's head on the anterior aspect of the thigh just beneath Poupart's ligament. Two years previously he had injured the interior aspect of the thigh in a fall. A year and a half after the injury he began to complain of pain and slight functional disturbance in the thigh and hip. The tumor had rapidly become larger. Its shape was oval with its long axis following the direction of the tendon of the psoas. The limb was in a position of flexion and any attempt to extend it aggravated the pain. Fluctuation was obtainable when the limb was flexed but absent when it was extended.

There was a second tumor of like characteristics located at the edge of the gluteus maximus. On pressure the posterior tumor could be made to disappear coincident with which it could be noted that the anterior increased in size. Evidently the tumors communicated with one another.

The fluid contained in the cysts was a thick, viscous, yellow fluid. It was demonstrated that the anterior cyst communicated with the cavity of the hip-joint.

**CASE VIII—PAGE (also Baker)** The patient a house decorator, was healthy except for rheumatism. For three years he had been bothered with pain in his left hip and knee. The affection had become progressively worse so that when first examined his hip was immovable. It was recorded at this time that there was a slight fulness below Poupart's ligament. Under treatment he was so improved as to be able to get out and do his work for six years. At the end of this time he returned with marked impairment of movement of the left knee and hip. The limb was three-quarters of an inch shortened and everted. The whole of Scarpa's triangle from Poupart's ligament to the middle of the thigh was occupied by a large hemispherical cyst of an approximate diameter of 18 cm. On tipping 42 ounces of yellow fluid were withdrawn. At a later date 40 ounces were withdrawn.

**CASE IX—PRINGRUBER (Perier's case)** The patient, a man of fifty-four years, had gradually noticed the development of a tumor in the inguinal region. There was some interference in movement. Pain was presented along the course of the anterior crural nerve. The tumor occupied the superior and external portion of Scarpa's triangle behind the psoas muscle, and was definitely prolonged up under the inguinal ligament.

## CYSTS OF THE ILIO-PSOAS BURSA

It was sharply circumscribed and both its intra- and extra-pelvic portions were easily outlined. In consistency it was hard, and gave the idea of fluid under great pressure. Anterior to the tumor on its medial aspect could be felt the pulsating femoral artery. The content of the tumor was the typical yellowish viscous fluid of such tumors.

**CASE X—SPRENGEL** A man, age fifty-one, had been suffering for a year from pain in the right knee. For the last five months he had noticed a swelling in the inguinal region, together with a feeling of weakness in the right leg. The patient limped markedly, but his pain was insignificant. The tumor was ovoid in shape, and located in the superior part of the thigh anterior to the hip-joint. It extended upwards beneath Poupart's ligament a little way into the pelvis downwards for a distance of 6 cm. below Poupart's ligament, medially as far as the junction of the medial third with the outer two-thirds of the ligament, and laterally as far as the anterior superior spine of the ileum. Fluctuation was present. There was no limitation of movement at the hip except that induced by the presence of the tumor mass. At operation one-third of a litre of thick yellow fluid was withdrawn. The sack had extensive communication with the hip-joint.

**CASE XI—DACRON (Le Dentu's case)** A man, aged sixty, had had a right inguinal hernia for two years. He noticed some vague pains in the right inguinal region, coincident with which was the development of a tumor (other than the hernia) the size of a walnut. The tumor was oval in shape, with the great axis corresponding to the fold of the thigh. It measured 8 x 5 cm. The beating of the femoral artery could be felt over the medial part of the tumor. Fluctuation was easily obtained. Movements of the hip were not painful. On aspiration 250 grams of thick, transparent, yellow fluid, rich in albumin, was obtained. At a later date an equal amount of the same sort of fluid was withdrawn. At operation no opening between the cyst and the joint cavity was seen. The patient died of purulent infection. At autopsy a connection between the two cavities was demonstrated.

**CASE XII—HORRA** A man, complained of pain in the region of the right hip and even extending down to the knee. A year previously he had injured the limb, but it had given him no trouble until this time. On examination the limb was seen to assume a position of partial flexion, with slight abduction and lateral rotation. Movement at the thigh in the opposite of these directions, *i. e.*, adduction, flexion, and medial rotation, was limited and painful. A tumor mass in the upper part of the thigh underneath Poupart's ligament was easily demonstrable.

**CASE XIII—SONNEBORN** A man, forty-six years of age, had been treated for a year for a rheumatic affection of the hip. There was no history of traumatism. Standing and walking were impossible. No signs of coxalgia. On the anterior aspect of the hip, in the neighborhood of the articular capsule, was a slight swelling, painful, and questionably fluctuant. Under the local treatment the tumor disappeared.

**CASE XIV—HERDTMANN** The patient had had his left leg crushed between two cars. A painful swelling of the ilio-psoas bursa developed. Flexion or medial rotation caused a great deal of pain.

**CASE XV—MOMMSEN** The patient had a painless tumor projecting from the region of the ilio-psoas beneath Poupart's ligament. The femoral artery was carried forward by the mass. The tumor was fluctuant and on pressure decreased in size.

**CASE XVI—MOMMSEN** A man, aged fifty, complained of difficulty in walking due to a swelling in the right inguinal region. It had increased in size until it was as large as two fists. It was firm in consistency, non-fluctuant, and but slightly movable. Pre-operative diagnosis was sarcoma of the fascia of the hip. At operation its true nature was determined.

**CASE XVII—COLTEAUD** A man, thirty-one years of age, had acquired syphilis six years previously. On the inner side of the thigh was a regularly outlined tumor mass, the size of an egg. Fluctuation could be obtained, and it was determined that



the fluctuant mass extended up into the pelvis. The hip-joint was normal. Puncture revealed that the contained fluid was of a clear yellow viscous nature.

CASE XVIII—DE WLCK and DUPREZ. A man, thirty-seven years of age, twenty-six years ago had suffered a fracture of the femur near its superior extremity. On healing the limb was shortened by two centimetres, and a certain amount of diffuse tumefaction persisted in the region of the groin. Four or five months previous to operation this tumefaction became painful and its volume decreased. On puncture a limpid, syrup-like liquid, very rich in albumin, was withdrawn. At a later date on reappearance of the tumor it was exposed and excised. It was about the size of an egg and fluctuant. The fluid contained was similar to synovial fluid. In addition to the fluid there were two whitish-yellow bodies composed of fibrous tissue, cartilage and bone contained within the sack. The tumor was in the position of the ilio-psoas bursa.

CASE XIX—DIBBIT describes the presence of three foreign bodies, each having the volume of a large nut, in a hygroma of the psoas bursa. They were not detectable previous to operation. The bodies had the appearance and structure of articulated foreign bodies but the hygroma did not communicate with the joint cavity.

CASE XX—PISANO. A woman, sixty-two years of age, had for two months been bothered with cramp-like pain in the left thigh, particularly on the posterior aspect, and in the hip-joint. About a month later she had noticed a swelling in the left inguinal region. Examination revealed a fluctuant, non-expansile tumor, in the upper part of Scarpa's triangle the size of the head of a full-term fetus. Thigh slightly flexed. Active and passive movement painful. Operation under local anesthesia disclosed the cystic tumor beneath the psoas and pectineal muscles, extending upwards for a considerable distance into the iliac fossa. The cyst wall was fibrous and contained about 400 cc of lemon-colored, slightly viscous fluid. On the inner surface of the sac there were several places where an endothelial lining was microscopically visible.

CASE XXI—CULLEN. A man, aged forty-six, had had a limp for ten years. He had been told that he had a tumor of the left hip. His left leg was stiff, and in walking the left hip-joint was held as immobile as possible. In the left iliac fossa was a mass perhaps  $8 \times 10$  cm, which seemed to occupy the greater part of the left half of the pelvis. This mass was continuous with a smaller mass which passed below Poupart's ligament. The tumor was made more prominent on extension of the thigh. At operation the tumor was found to contain a clear viscid fluid, yellowish in color, together with six irregular cartilaginous masses lying free in the cavity. The wall of the tumor was composed of fibrous tissue through which were scattered plaques of cartilage and bone. The sac communicated with the synovial cavity of the hip-joint.

CASE XXII—KUMMER. A man, aged fifty-nine, had been perfectly well until four years before. At that time he was bothered with a sharp pain in the antero-superior region of the hip. The pain frequently radiated to the knee. This gradually increased in severity. A year later there was noticed a slight swelling in the inguinal region. The articular movements were free. Under local treatment, the condition improved, only to recur four years later with the same inguinal swelling. The limb was in a position of slight flexion and outward rotation. Walking was painful and accomplished with the aid of a cane. In the inguinal region was a fluctuant tumor extending upwards beneath Poupart's ligament, and downwards as far as the region of the lesser trochanter. The femoral vessels were crowded inwards and forwards. The limb showed evidences of circulatory disturbances in the form of diffuse oedemas, varices and purple patches. Movement at the hip was quite free except that extension and flexion were slightly limited, and internal rotation was almost abolished. The integrity of the bones was demonstrated by X-ray. On aspiration a viscous, mucoid fluid, yellowish in color, was obtained. As much as 250 cc were aspirated at one time. At operation the fibrous sac was seen to communicate with the hip-joint.

CASE XXIII—LUND. A man, aged seventy, entered the hospital with a lump in his right groin, which caused considerable pain and stiffness of the leg. There had been no

## CYSTS OF THE ILIO-PSOAS BURSA

movement of the bowels for two days. A diagnosis of strangulated hernia was made by another physician. The man was emaciated and showed osteoarthritic deformities of the finger joints. In the inguinal region behind and external to the femoral artery and just below Poupart's ligament was a fluctuating tumor half the size of an egg. A tentative diagnosis of deep abscess in front of the hip was made. Operation revealed a thin-walled cyst lying to the inner side of, and beneath, the ilio-psoas tendon. The cavity contained an ounce of serofibrinous fluid. The sac communicated with the hip-joint.

### BIBLIOGRAPHY

- Auvray Kyste developpe dans la bourse sereuse situee sous le psoas Bull et mem Soc de Chir de Paris, 1919, vol xlv, p 980
- Baker, W Marrant St Bartholomew Hosp Reports, vol xxi, 1885
- Charleston Jl of Americ Med in Centralblatt, 1880, p 127
- Chassaignac Traite de la suppuration et du drainage, 1859, t ii
- Churchman Luetic Bursopathy of Verneuil The Amer Jl of the Med Sc, Sept, 1909
- Cullen A Large Cystic Tumor Developing from the Ilio-psoas Bursa J A M A, vol lv, April 9, 1910
- Dagron (Le Dentu's case) Hygroma de la bourse sereuse du psoas-iliaque, mort par infection purulente Bull soc Anat de Par, 1891, vol lxxvi
- Durville (case of Schwartz) L'hygroma de la bourse sereuse du psoas, 1895
- Delbet Corps etranger contenu dans un hygroma de la bourse du psoas Bull et mem Soc de Chir de Paris, 1902, vol xxviii, p 1264
- Fricke Jl der Chirurgie und Augenheilkunde, 1834, t 21, p 235
- Heineke Memoire paru a Erlangen, 1868, p 104
- Hoffa Monatsschrift f Unfallheilk, 1889, vol c, p 287
- Joly These inaugurale Paris, 1847 (Velpeau's case)
- Kummer Un cas d'hygroma chronique de la bourse du psoas-iliaque ou ilio-pectinee Rev med de la Suisse Rom, Geneve, 1917, vol xlxvii, p 574
- Lund The Ilio-psoas Bursa, its Surgical Importance and the Treatment of its Inflammatory Conditions with Report of Three Cases Boston Medical and Surg Jl, vol cxlvii, 1922
- Maissoneuve (Natalis Guillot's case) Clinique Chirurgicale, Trad franc, t xiv
- Mommsen Zwei f alle gutartiger grosser Schleimbent el hygrome Deutsche med Wchnschr, Leipz u Berl, 1895, vol xx, pp 107-109
- Mondain Un cas de communication directe de la bourse sereuse du psoas-iliaque avec la synoviale de l'articulation coxofemorale Arch Med d'Angers, 1889, vol iii
- Paget Tr Path Soc of London, 1884, p 342
- Pisano Un cas di igroma della borsa sierosa dello psoas iliaco Policlin Rome, 1913, vol xx, Sez prat, pp 415-445
- Prengieuber (Perier's case) Gaz Hôpitaux, 1885
- Rose The Lancet, 1873
- Schaeffer Centralblatt fur Chirurgie, 1880
- Sonneborn Inaugr Dissert Marbourg, 1894
- Sprengel Centralblatt fur Chirurgie, 1887
- Volkman (Werner's case) Krankheiten der Gelenkorganen, t ii
- de Weck and Duprez Hygroma de la bourse sereuse du psoas du a la presence de corps libres consecutifs a une fracture ancienne du femur Rev med de la Suisse Rom, Geneve, 1900, vol xx
- Zuelzer Die Schleimbentel der Huft und deren Erkrankungen Deutsch Ztschr f Chir, 1898, vol xlix

# VERTEBRAL EPIPHYSITIS

By PHILIP LEWIN, M.D.

OF CHICAGO III

ASSISTANT PROFESSOR OF ORTHOPEDIC SURGERY, NORTHWESTERN UNIVERSITY MEDICAL SCHOOL

*Historical*—Under the term *kypnosis dorsalis juvenilis*, Scheuermann of Copenhagen, in 1921 described this unusual affection of the spine.

*Literature*—The literature on this subject is very scant. In the most recent article by Calve, two cases are described, one seen by Calve and the other by Brackett. Similar to the case here reported, both of these authors believed they were dealing with Pott's disease.

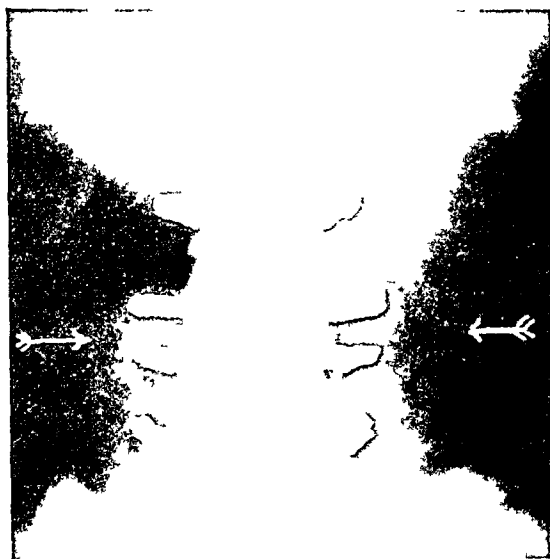


FIG. 1—Fusion of third and fourth lumbar vertebral simulating, bilateral double transverse processes (Antero-posterior view.)

*Embryology*—The embryology of the spine offers information of great interest and importance. There are two epiphyses for each vertebral body, one at the upper pole and one at the lower. These unite with the body at about the eighteenth year; therefore epiphysitis cannot occur after this period. However, before this period of fusion occurs the vertebral epiphyses are subject to the same conditions that any epiphysis is.

*Etiology*—The etiology of this condition is found in the following factors: First, infection locally and remotely, secondly, circulatory disturbance in the nature of embolism, thrombosis, etc., thirdly, trauma both internal and external, and fourthly, glandular disturbance, affecting bone growth and development.

*Pathology*—The pathology is that of an epiphysitis.

*Symptoms and Signs*—The signs of an epiphysitis are similar to those of an early tuberculosis, *viz.*, limitation of motion, muscle spasm, military attitude, pain, night cries, tenderness and sensitiveness to jarring.

*Rontgenography*—Antero-posterior and lateral views should be made and reveal characteristic involvement in region of epiphysis. No exudate is seen.

*Diagnosis*—The direct diagnosis is based upon the findings outlined above. The differential diagnosis is important especially from the standpoint of prognosis.

The conditions to be considered are especially tuberculosis, rickets, and trauma. *Tuberculosis* is manifested by limitation of motion, muscle spasm, pain, night cries, rontgenographic evidence, *v. e.*, haziness and diminution of

## VERTEBRAL EPIPHYSITIS

intervertebral space, destruction of bone in anterior portion of vertebral body exudate, deformity, abscess, etc. *Rickets* is characterized by a long, round kyphos, which is easily reducible, other evidences of rickets, such as rosary, square head, irregular broad epiphyses, pot belly, Harrison's groove, bone deformities, *i e*, knock-knees, bow-legs, etc., disturbed dentition and altered blood chemistry. *Traumatic* spine conditions are diagnosed by a history of injury, examination of the spine and roentgenographic studies. A complete differential diagnosis is given in a paper by the writer in the *Illinois Medical Journal* for January, 1925.

*Prognosis*—The prognosis is excellent if proper treatment is instituted.

*Course*—The course is comparatively short. Undoubtedly many cases reported as cured tuberculosis of the spine were really cases of epiphysitis.

*Treatment*—The treatment should be the same as for mild or early tuberculosis, *viz* Absolute recumbency on a bed frame made of gas pipe, according to Bradford or Whitman, with traction applied to the head or legs or both.

Immobilization accomplished by plaster-of-Paris cuirass or spine braces.

Heliotherapy is most valuable, and if it can be properly given, is probably the only treatment necessary, excepting a simple spine support. Hygienic conditions must be maintained. Dietetic factors are very important. If glandular disturbances are present they should be treated. All foci of infection should be removed.

**CASE REPORT**—The case here reported has been under observation by Dr. John L. Porter and the writer, over a period of about nine years. It is not a proven case. Having been diagnosed and treated for tuberculosis of the spine, she made a complete recovery with perfect motion and no deformity. The writer therefore believes it was not tuberculosis but vertebral epiphysitis.

V. H., white girl, age thirteen years, a pupil at The Spalding School for Crippled Children, was first seen by Dr. John L. Porter at St. Luke's Hospital, when she was three years old, when the following data was obtained:

*History*—Complaint of pain, tenderness and rigidity of spine. *Personal History*—Birth normal, June 6, 1911. Breast fed, walked at twelve months and talked at two years.

*Precious Diseases*—Measles, whooping cough, pneumonia, typhoid.



FIG. 2.—Line of fusion of third and fourth lumbar vertebrae at junction of upper and middle thirds of composite vertebra (Lateral view).

*Family History*—Her father and brother are well. Her mother has "kidney trouble." Her father's sister died of tuberculosis four years ago, and her mother's sister died of intestinal tuberculosis. The child has never been in contact with any of the family who had tuberculosis.

*History of Trouble*—Child is said to have curvature of the spine, which father noticed when she was three years old. Her stomach began to be prominent. There were no other symptoms. Her back became steadily worse. Two months ago she complained of pain on right side. This was present at night only. She cried during sound sleep. This has become more constant during past two weeks. At present night pains trouble her. She eats well except when teeth bother her, many teeth are decayed and loose. Her father thinks she is losing in weight and strength. She was referred to The Children's Memorial Hospital where a diagnosis of tuberculosis of the spine was made and proper treatment recommended. She was referred to St. Luke's Hospital, where she was examined by Doctor Porter and the writer, and the following findings observed:

*Physical Examination*—Muscle spasm of marked degree, tenderness to pressure and sensitiveness to jarring over the second and third lumbar vertebrae. The lumbar spine is rigid in all directions. There is a slight left scoliosis. There is a marked lumbar lordosis. Her mouth and teeth are in very bad condition.

Röntgenograms (which unfortunately have been lost) revealed evidence of tuberculosis of the third lumbar vertebra.

She was treated by absolute recumbency on a Bradford frame with head traction and elevation of the head of the bed. This was followed by repeated plaster-of-Paris jackets and finally a Taylor spine brace.

At present she is evidently cured. She has perfect spine movements without a sign of deformity and has no symptoms whatsoever. She was demonstrated by the writer before the Central States Orthopedic Club in 1919, as a case of cured tuberculosis of the spine with perfect motion and no deformity.

Röntgenograms reveal in antero-posterior projection (Fig. 1) what appear to be bilateral double transverse processes of the fourth lumbar vertebra, but is in reality a fusion of two vertebrae. The third and fourth lumbar vertebra have united. In the lateral view (Fig. 2) there can be seen a definite line of fusion at the junction of the upper and middle thirds of this composite vertebra.

*Conclusions*—Vertebral epiphysitis is a definite pathological entity and is analogous to Legg-Calve-Perthes disease of the hip, to Osgood-Schlatter's condition in the upper tibial epiphysis, to Kohler's tarsal scaphoiditis, to Freiberg's infraction of the metatarsal head, to carpal epiphysitis, and to apophysitis of the os calcis.\*

## BIBLIOGRAPHY

- Calve. *Revue de chirurgie*, 1910, vol. xlii.  
 Calve. *Journal of Bone and Joint Surgery*, vol. vii, No. 1, Jan., 1925, p. 41.  
 Kohler, A. *Grenzen des Normalen und Anfänge des Pathologischen in Röntgenbild*, Hamburg, 1915, S. 153.  
 Lewin. *Ill. State Med. Journ.*, Jan., 1925, vol. xliii, No. 1, p. 41.  
 Perthes. *Archiv für klinische Chirurgie*, Juni, 1913.  
 Schanz. *Jahrbuch für Kinderheilkunde*, 1911.  
 Scheuermann, H. *Zeitschr. f. Orth. Chir.*, vol. xli, June, 1921, p. 305.  
 Schulthe. *Joachimsthal's Handbuch der orthopädischen Chirurgie*, 1905-07, vol. ii, Teil.  
 Schulthess. *Zeitschrift für orthopädische Chirurgie*, 1917, S. 761.  
 Sorrel and Delataya. *Presse Med.*, 1924, vol. xxxii, p. 737.  
 Tubby. *Deformities*, London, 1912.  
 Virchow, H. *Berliner klinische Wochenschrift*, vol. xxxviii, pp. 1916 und 32, 1916.

\* Recently Stern, of Cleveland, demonstrated a similar condition in the lower tibial epiphysis.

# CLOSED REDUCTION OF ACUTE DISLOCATIONS OF THE SEMILUNAR CARPAL BONE

BY H. EARLE CONWELL, M.D.  
OF FAIRFIELD, ALA.

THESE particular cases are reported because of the successful attempts at the closed method of reduction, the full functional results obtained and the complications of a fractured scaphoid and fracture of the styloid process of ulna in case one, and a fracture of the styloid process of the ulna in case three.

Dislocations of the semilunar carpal bone are frequently undiagnosed because of the failure to make a thorough physical examination with proper radiographic interpretation in every suspicious injury to the wrist-joint. Because of these incomplete examinations marked disabilities have resulted.

If semilunar dislocations are diagnosed immediately following injury and the closed method of reduction attempted, as described by Davis, the majority can be reduced, thereby lessening a long period of disability as well as obtaining good functional results. In this method care should be taken that too much trauma is not used because marked injury can be done to wrist-joint structures causing greater disability than if the dislocation had been left alone and later the bone removed. However, no disability resulted from trauma in any of these cases. The use of the fluoroscope is indispensable in this type of case and should always be used.

Briefly outlined, the closed reduction method, or broomstick method of Davis, is as follows. The curved surface of the side of a broomstick handle is placed at the lower tip of the semilunar bone on its radial articular aspect. By increasing the deformity of the dislocation, that is, extreme extension of the wrist, and by gradually making traction on the hand, with broomstick in place making pressure against the dislocated semilunar, the hand and wrist are acutely flexed, causing the semilunar to be reduced. The traction on the hand is important, because this increases the space between the radius and os magnum, making room for the semilunar carpal bone. Extreme flexion is also necessary.

In this series of cases it was found that when the wrist remained in right angle flexion without force and did not have a tendency to rise up, the semilunar was always reduced.

Diathermy in sedative doses, with radiant light, was found to relieve the pain and rapidly diminish swelling as well as lessen the period of functional disability. Immediate mobilization of wrist as soon as possible is very important.

The force producing the dislocations was found to be directed from the

flexor to the extensor surface of the wrist, with the wrist and hand in extreme extension

CASE I—On September 17, 1924, while loading a coal car, L. H., colored male, twenty-four years old, miner, received an injury to right wrist. L. H. stated he caught his hand between a car and the roof of the mine at the same time causing a very marked backward bending of the wrist. The patient was seen by me four days later. Examination showed marked swelling and tenderness of right wrist, with very limited motion. Radiographic examination of the right wrist revealed a dislocation of the scapholunar bone with fracture of the scaphoid and fracture of styloid process of right ulna (Fig

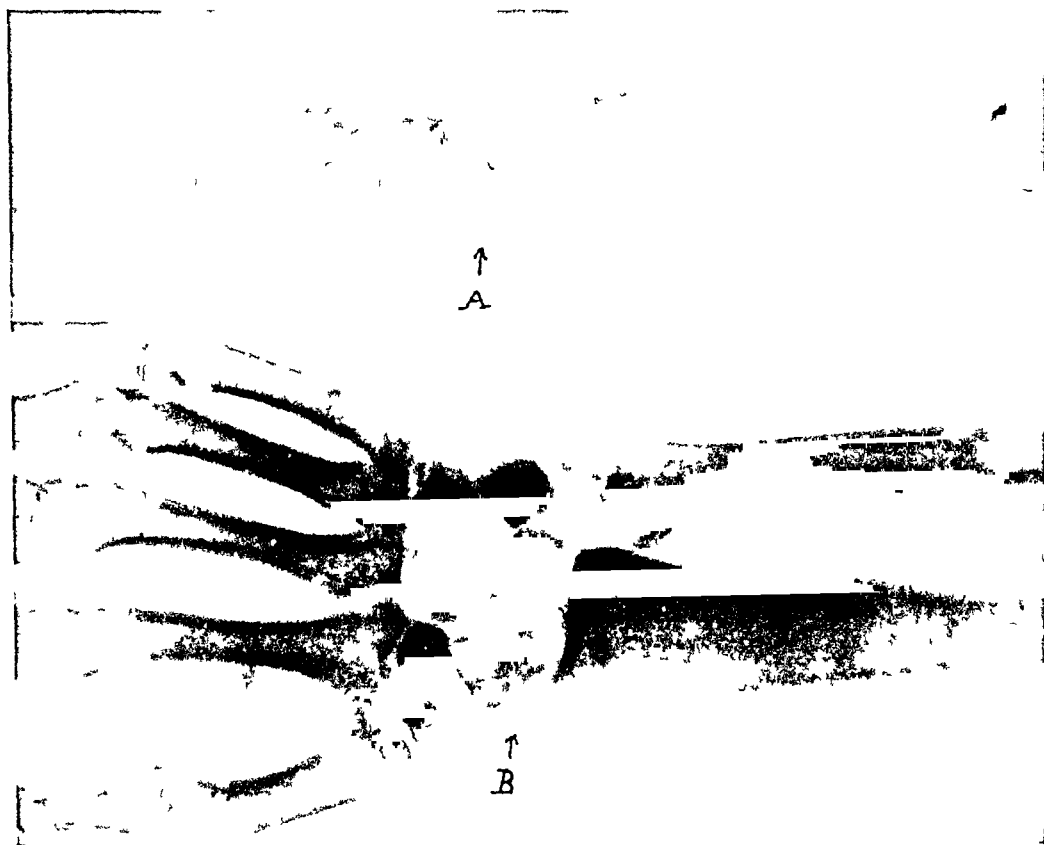


FIG. 1.—Rontgenogram showing dislocation of scapholunar bone with fracture of scaphoid and ulnar styloid process. A Lateral view. B Antero-posterior view.

1, A and B) Ether anæsthetic was given September 12, 1924 and the closed reduction method used.

Successful reduction was accomplished, the wrist was placed at an angle of 15 degrees flexion and 20 degrees adduction. The right thumb was adducted to base of the index finger and anterior and posterior wooden splints applied. On the fifth day, splints were removed daily and hot baths applied to wrist and hand. On the sixth day the wrist was placed on a cock-up splint and thumb was kept adducted. Active motion was also accomplished daily after the sixth day. The wooden splints were entirely removed on the fourteenth day, and diathermy was commenced daily and used for four weeks thereafter, as well as daily hot baths, radiant light, active and passive motion. Radiograph six weeks following injury showed good union of fractured scaphoid and fractured styloid. The patient returned to work in eight weeks following injury. There were full functional results in this case. Patient's delay in returning to work earlier than eight weeks was due to the fractured scaphoid.

## DISLOCATIONS OF SEMILUNAR CARPAL BONE

CASE II—While loading timber on a car, August 14, 1924, L M, colored male, age twenty-seven, miner, caught his right hand between two timbers, twisting his wrist and at the same time bending his wrist and hand backward. The patient was seen by me on August 23, 1924, nine days following injury. Examinations of the right wrist showed very marked swelling and tenderness with limited motion. Radiograph showed dislocation of right semilunar bone. Ether anæsthetic was given on August 23, 1924, and the closed method used. Reduction was successful. The wrist was placed in 15 degrees flexion and 20 degrees adduction and anterior and posterior splints applied. Wrist brought to mid-flexion and extension on third day. Splints were entirely removed on the sixth day and hot baths, diathermy massage, radiant light and active and passive

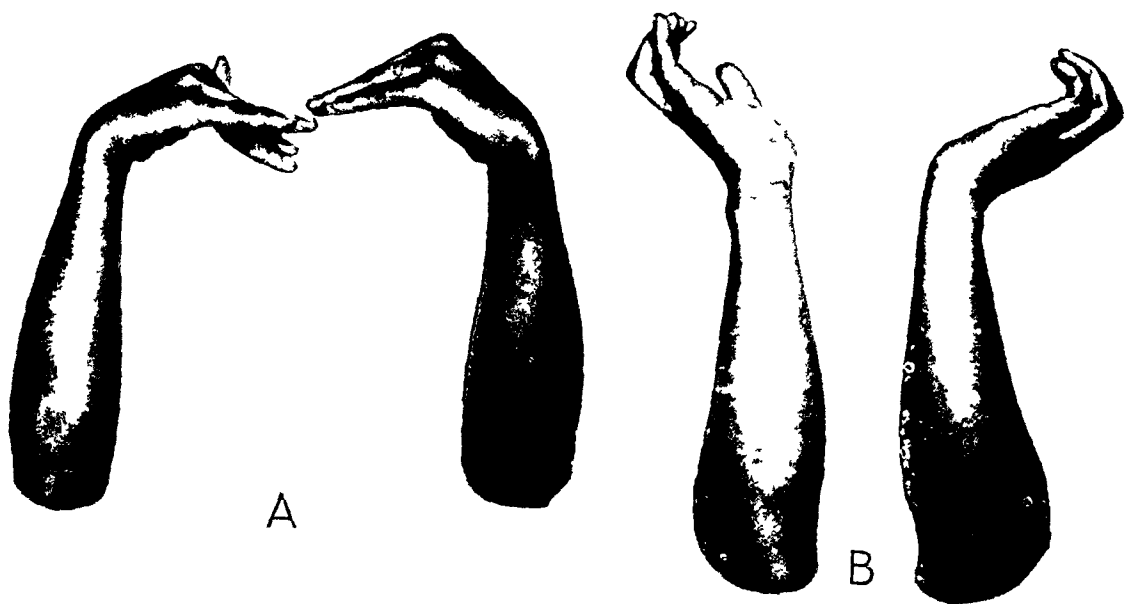


FIG. 3—Final results obtained in Case I, L. H., as regards flexion and extension of the injured wrist  
A Flexion B Extension

motion were used daily. The patient had excellent functional results, and he returned to work four weeks following the closed reduction.

CASE III—On March 26, 1925, A. P., white male, age fifty, carpenter, stated that he fell off a scaffold about ten feet high, catching all his weight on his right hand while hand was in full extension. Was seen by me on March 29, 1925. Radiographic examination showed dislocation of the right semilunar carpal bone and fracture of styloid process of the right ulna. Physical examination showed right hand and wrist very swollen with marked tenderness and practically no flexion or extension in wrist. Ether anæsthetic given March 29, 1925, and the closed method used. Successful reduction was accomplished, posterior wooden splints applied with wrist in 20 degrees adduction and 15 degrees flexion. Hand was placed in mid-flexion and extension at wrist on the fourth day and hot bath was given to hand and wrist daily thereafter. Wooden splints were removed entirely on the eighth day, and diathermy commenced daily. Patient was allowed to gradually use active and passive motion. Was able to return to work within five weeks from date of injury. Good functional results obtained.

### SUMMARY

- 1 All injured wrists should have careful physical and radiographic examinations.
- 2 Closed reduction should be attempted on all acute dislocations of semilunar carpal bones.



3 Great care should be exercised as regards too much trauma in using the closed reduction

4 Diathermy, active and passive motion and hot baths should be commenced as early as possible

N B—I am indebted to Dr G Walsh and Dr I M Gravlee, Rontgenologist, Employees Hospital Fairfield, Alabama, for their able assistance in these cases

#### BIBLIOGRAPHY

Davis Geo G Surgery, Gynecology and Obstetrics, August, 1923

Cohn Isidore ANNALS OF SURGERY May, 1921

# ARTERIOVENOUS FISTULA

By THOMAS HERBERT THOMASON, M D

OF FORT WORTH, TEXAS

ARTERIOVENOUS aneurism, owing to its spectacular pathology and comparatively rare occurrence always excites more than a passing interest. The World War with its hitherto unprecedented incidence of vascular injuries afforded ample opportunity for the study of the immediate and remote developments arising from this particular condition, and recent literature has been enhanced by a number of excellent contributions to our knowledge of the subject. Particular stress has been laid on the effects of an arteriovenous fistula on the cardiovascular system, which have been thoroughly studied experimentally and clinically by Reid, Matas, Holman and others. The following case may be of interest as illustrating particularly the reaction of the cardiovascular system to an arteriovenous fistula of long duration.

CASE—V B, a cattleman, aged twenty-four, came to us in July, 1923, complaining of a persistent sore on his left leg of some two years' duration. His family history and personal history were entirely negative. Ten years previously he had received a stab wound low down in his left thigh on the medial aspect. There had been much bleeding at the time, but the wound had healed promptly and had given no trouble until two years ago. At that time he was cut by barbed wire on the outer aspect of his left leg, sustaining a wound which persisted for two years, during which time he was able to do practically no work. He had no other complaint.

The patient was a well-developed, muscular man, apparently in good physical condition. There was a slight cyanosis of the face which amounted, apparently, to little more than a healthy flush. One was immediately impressed with the unusual appearance of the left leg and thigh. The left limb was definitely larger than the right. The superficial veins and capillaries of the left leg were greatly engorged and the skin had a mottled cyanotic appearance, resembling that of extensive varicose veins. On the outer surface of the leg, in the area of greatest discoloration, was a linear ulcerating wound. This healed promptly after application of a pressure bandage. On the inner aspect of the left thigh, in its lower third, was the small scar of a stab wound received ten years ago.

On palpation of the thigh a continuous thrill was felt which was most marked in the region of the scar and was perceptible from Poupart's ligament down to the ankle. It was reinforced and intensified with each heart beat. Auscultation of the thigh revealed a loud, characteristic bruit—a "continuous roaring sound like that of distant machinery or of a train passing over a bridge." This could be heard well up in the abdomen. There was marked pulsation of the femoral vessels on the left above the fistula. Pressure over the scar resulted in cessation of the thrill and bruit. The same effect was obtained from pressure over the femoral vessels below Poupart's. No pulsation could be made out in the left dorsalis pedis and posterior tibial arteries. Pulsation in the superficial veins of the leg was not observed. There was no marked difference in the temperature of the two limbs. The patient said they felt about the same.

While there were no cardiac symptoms in the history the heart was greatly enlarged. The P M I was seen and felt in the fifth interspace  $7\frac{1}{2}$  cm from the midline. The relative cardiac dullness extended 10 cm to the left by 5 cm to the right. On auscultation the heart sounds were regular and forceful. There was a barely perceptible systolic

murmur best heard at the base. Aortic and pulmonic second sounds were both diminished in intensity. The heart sounds were exceptionally clear in the fourth interspace on the right.

The pulse was regular in force and rhythm, of good volume, rate 92, tension (brachial) 120/45. Branham's bradycardiac phenomenon was marked in this case. When the fistula was so compressed as to cause complete cessation of the bruit, the pulse fell immediately to 72 and the diastolic pressure rose from 45 to 80, the systolic pressure remaining unchanged at 120.

*Special Examinations*—A teleo-rontgenogram showed a combined measurement of

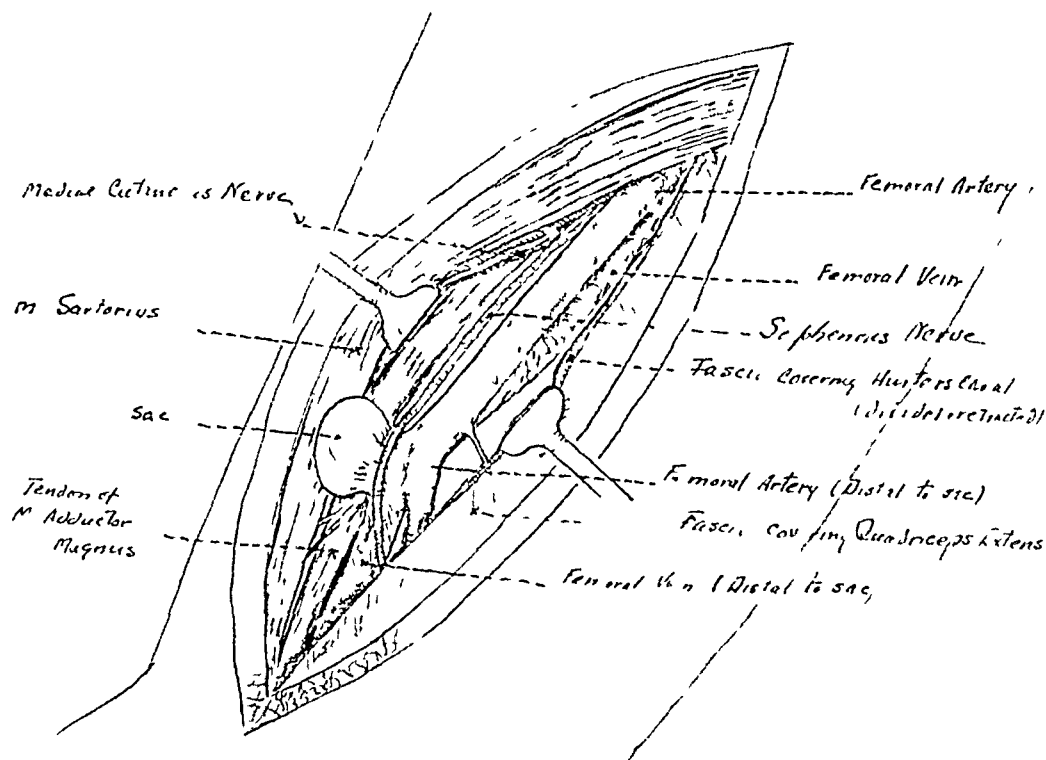


FIG. 1.—Sketch of the fistula between the femoral artery and vein as seen at the operation.

17½ cm., verifying previous observations on the heart. At a later date the above pulse and blood-pressure observations were verified with the following results:

Blood-pressure prior to occlusion of fistula, 128/66

Pulse prior to occlusion of fistula 92

Blood-pressure after occlusion of fistula, 128/92

Pulse after occlusion of fistula, 60

It was apparent from these readings that occlusion of the fistula lowered the pulse-rate 32 beats while at the same time it elevated the diastolic pressure some 26 millimetres. The systolic pressure showed no variation.

The following test was made to ascertain the efficiency of the collateral circulation. The fistula was occluded by compression until thrill and bruit had ceased. An Esmarch bandage was then applied from the toes to the knee and left in place ten minutes. It was then removed, and it was noticed that the hyperemic wave of returning blood advanced rapidly downward into the foot and toes, showing the presence of adequate collateral channels. It is obvious that this observation was very comforting to the surgeon, who is always confronted in these cases with the possibility of gangrene of the parts distal to the fistula.

Laboratory examinations were essentially negative. Red blood-cells numbered

## ARTERIOVENOUS FISTULA

4,290,000, leucocytes, 10,300, and the hæmoglobin was 90 per cent The urine was negative

*Operation*—On February 7, 1924, operation was performed by Dr F C Beall under local anæsthesia No tourniquet was used With the knee and thigh slightly flexed, incision was made over the lateral border of the sartorius muscle, which was exposed and retracted The medial cutaneous nerve of the thigh was seen beneath it The fascia overlying Hunter's Canal was incised, exposing the femoral artery and vein and the saphenous nerve lying in the adductor canal In the lower end of the canal a tense rounded sac was seen, in size slightly smaller than the distal phalanx of the thumb, which protruded from the wall of the femoral vein medial to the saphenous nerve, which was densely adherent thereto Just proximal to this sac the artery and vein were joined together, the vein passing around medial and superficial to the artery, which ducked away inward toward the popliteal region (Fig 1) It was noted with interest that the proximal artery was not as large as we expected to find it, being only about three-eighths of an inch in diameter The distal artery was about half as big

The femoral artery was now occluded above the fistula with apparently little effect on the thrill or the sac, which still remained tense Inspection of the lower leg after this manœuvre revealed the circulation unimpaired Both afferent and efferent veins were now occluded and the sac became very tense due to blood entering it through the distal artery—again assuring us of adequate collaterals

All four radicals were now ligated with linen, and the fistula was excised The femoral artery was increased in diameter by a half, and the pulse which had been 92 fell immediately to 40 The circulation in the leg remained good Examination of the excised fistula showed the artery and vein tightly glued together with a slit-like communication in cross-section about the size of an ordinary lead pencil

The following observations were made on the pulse and blood-pressure after operation

- (1) Immediately after operation Pulse 56, regular, blood-pressure, 142/90
- (2) Second day, A M Pulse 68, regular, blood-pressure, 150/80
- (3) Third day, A M Pulse 68, regular, blood-pressure, 135/80
- (4) Third day, P M Pulse 78, regular, blood-pressure, 128/88

Recovery in the hospital was uneventful, except for a slight wound infection, which cleared up rapidly On the second day after operation a good pulsation was made out in the posterior tibial artery (none had been detected prior to operation) but none in the dorsalis pedis The patient was discharged at the end of the second week in good condition When seen on February 23, he was still doing well His pulse was regular, about 80 There was no swelling in the leg, which had lost its cyanotic appearance and appeared even smaller than the right leg, whereas before operation it had been larger

On February 29 he looked badly and had evidently lost some weight During the week previous he had been easily tired, though doing no work, and had not felt well Examination revealed a pulse exceedingly irregular both in rate and force of the beats There were many extrasystoles with a pulse deficit of about 40 The pulse could not be counted with accuracy, but was well over 100 per minute at the apex The blood-pressure was 112/65 Evidently we were dealing with a greatly disturbed cardiac mechanism

The patient was sent to the hospital, where after a course of rest and digitalis his arrhythmia disappeared When discharged on March 13, his pulse was 100 and quite regular, his blood-pressure was 108/70 He felt well and seemed much improved There was no swelling in the left leg A note from his physician dated August 12, 1924, reports his blood-pressure 115/70 and his pulse 80 to 92, full and regular He adds that the patient does general ranch work, avoiding heavy lifting and "extra-hard broncho-busting" and is to all appearances a normal man

*Comment*—In a discussion of the preceding case several features are worthy of note. These are, briefly, (1) Brianham's bradycardiac phenomenon and associated blood pressure variations, (2) The presence of marked cardiac hypertrophy and dilatation without other symptoms of decompensation, (3) The relatively slight dilatation of the proximal artery, (4) The well developed collateral circulation, and (5) The unusual and remarkable cardiac behavior following operation.

The behavior of the pulse in this patient is typical of the phenomenon first observed in 1890 by Brianham, a Georgia surgeon, and named accordingly Brianham's bradycardiac phenomenon. These observations were made before the days of accurate blood pressure estimation and concerned only variations in the pulse rate. Later it was found that these pulse variations were accompanied by coincident changes in the general blood pressure. In this case it was observed that when the fistula was completely closed by external pressure the pulse rate fell immediately from 92 to 60, while the diastolic pressure rose from 66 to 92. Interesting to relate, the systolic pressure remained practically at 128.

Holman in the *Archives of Surgery*, July, 1923, presented a somewhat similar case of popliteal arteriovenous fistula of twenty-five years' duration with marked cardiovascular changes. He found that "closure of the fistula by simple compression caused a momentary increase in general blood pressure from 118/66 to 160/90 with a rapid subsidence to 126/88, where it remained until the fistula was again opened. Then it fell precipitately to 96/48 with a rapid recovery to 116/66. Pulse variations accompanied these changes, a pulse of 76 dropping to 38 when the fistula was closed, with recovery to 80 when the fistula was opened."

In that and in subsequent contributions to the subject Holman has worked out thoroughly the physiology of this phenomenon. He has shown that perhaps the most important readjustment following the production of an arteriovenous fistula is an increase in the total blood volume which is proportional to the size and duration of the fistula. Closure of the fistula by compression or excision restores the normal vascular mechanism—except for this increased blood volume, and is followed immediately by an attempt on the part of the heart to readjust itself to the new situation. This reaction, as we see it here illustrated, is Brianham's sign. Failure of the heart to react thus—i.e., absence of Brianham's sign—may be sign of a greatly weakened myocardium and therefore of bad prognostic import.

A very interesting finding in this case was the marked enlargement of the heart which was readily apparent clinically and strikingly shown in the teleorontgenogram. Clinically, there was definite preponderance of the right heart. The X-ray revealed a regular "cor bovis" with a combined diameter of 17.5 cm. Holman's case showed a similar enlargement with a combined diameter of 15.8 cm. That this is by no means the rule is shown by the fact that in the 447 recorded cases studied by Callander only 16 showed cardiac

## ARTERIOVENOUS FISTULA

dilatation and hypertrophy accompanied occasionally by auricular fibrillation and myocardial decompensation. Interesting to relate, our patient complained of no symptoms of decompensation, and after his leg ulcer yielded to pressure bandaging, was able to do a days work up to the time of operation. The fact that he had a large heart which would eventually fail under its increasing burden, formed the main indication for operation.

That this enlargement of the heart is caused by both dilatation and hypertrophy is a reasonable assumption and has been demonstrated by Holman in experiments on dogs. He found that after an arteriovenous fistula had been established and allowed to persist for a certain length of time, there occurred in addition to the marked cardiac dilatation a definite increase in the weight of the heart, which he concluded must be hypertrophy.

The reason for this hypertrophy is increased work imposed on the heart somewhat as follows. In the presence of a fistula there is a marked fall in arterial pressure due to the leak in the arterial system, which is likewise the cause of a tremendous increase of pressure in the vena cava. In order to maintain sufficient pressure in the arteries to sustain life, the heart must put forth in a given time a greatly increased volume of blood. In addition to this it is whipped up from behind, so to speak, and made to beat faster by the onrush of blood into the right auricle. With the increased blood volume it dilates promptly and in due time hypertrophy naturally ensues.

Of the 447 cases of arteriovenous fistula studied by Callander a rather small percentage, 12.7 per cent, showed proximal dilatation of the artery. It is interesting to note that our case showed little enlargement of the artery above the fistula—far less than we expected to find considering the remoteness of the initial injury. A discussion of this case would be incomplete without a consideration of the cause of this phenomenon. Holman gives us a very thorough and concise explanation in the following: "An explanation of the proximal dilatation of the artery and vein is found by reverting again to our conception that the introduction of a fistula into the circulation results in establishing two systems of circulating blood where only one existed before, namely A, heart-artery-capillary bed-vein, and B, heart-artery-fistula-vein. It is obvious that the volume of blood that is short-circuited through system B depends on the size of the fistula, the character of the opening, and the absence of any venous obstruction proximal to the fistula. If the fistula is large enough, the entire volume of blood flowing into the artery proximal to the fistula will be diverted through the opening. If the fistulous opening is larger in cross-section than the artery, and if there is no venous obstruction proximal to the fistula, the only curb to the amount of blood that will flow through the fistula is, first, the limited distensibility of the arterial wall leading to it, and, second, the resistance to expansion of the artery offered by the tissues and structures surrounding the vessel. The artery, however, is an elastic tube and the surrounding structures are non-rigid, compressible tissues. As a result, resistance to distensibility is in fact small, and, obeying the

maxim that flowing water seeks the path of least resistance, a larger and larger volume of blood will find its way into the vessel and through the fistulous opening, thus producing by the force of the column of blood directed toward the fistula, a gradual distention and dilatation of the feeding artery and receiving vein. This distention responds slowly but certainly to the increasing blood volume flow, until a point is finally reached where the combined resistance to the blood flow offered by the fistulous opening itself, plus the limited distensibility of the vessel wall to a further dilatation of the vessel, equals the resistance to the blood flow offered by the capillary bed in the system A. When this equalization of resistances is reached, the two systems are in equilibrium, the volume of blood flowing through the fistula will no longer increase, and therefore the total volume will also remain constant. It is my belief that when this equilibrium is reached, no further dilatation of the vessels and heart can or will occur. This dilatation is accomplished against the resistance to expansion offered by the vessel itself, and by the resistance offered by the surrounding tissues. It is, therefore, of necessity a slowly progressive process, and all writers have emphasized the long duration of the fistula as a prominent feature of the vessel and heart changes, when in reality the most important factor is the size of the fistula and the absence of any obstruction in the vein proximal to the fistula. Duration of the fistula is obviously not the reason for the dilatation, but in the presence of a large fistula it has a distinct bearing on the extent of the dilatation."

From the above it is apparent that the minor degree of dilatation of the proximal artery in this case was due to the fact that the size of the fistulous opening was no greater, but probably less than the area of the artery in cross-section. It will be remembered that the leak was about the diameter of a common lead pencil. The facts in our case tend, then, to verify Holman's statement.

A fourth feature to be noted in this case was the very efficient collateral circulation which made possible ligation of all four radicals and excision of the fistula. The improvement in the circulation of the leg was prompt and remarkable, and the customary bugaboo of gangrene troubled us not at all. The patient would have had an uneventful recovery but for the appearance of a complication which may be considered as a fifth outstanding feature of this case.

It will be noted that observations on the pulse and blood pressure after operation showed a marked increase in both systolic and diastolic pressures with a corresponding slowing of the pulse. By the third day the systolic blood pressure had returned to its pre-operative level. The diastolic reading remained at a normal figure, 80, and the pulse came up to 72 and was regular. On February 23 after being up and about the patient continued to be in excellent shape. Five days later we were rather amazed to see him pale and weak and suffering from shortness of breath. His pulse was definitely that of auricular fibrillation. The blood pressure had fallen to 112/65. After a period

## ARTERIOVENOUS FISTULA

of rest and appropriate medication he improved, and six months later showed no effects of myocardial disease

Although auricular fibrillation in an overburdened heart has been noted occasionally in these cases prior to operation, I find to mention of its occurrence after repair of the fistula, as is so strikingly shown in our patient. Matas mentions a temporary post-operative tachycardia which came on immediately after repair of the fistula in three cases of femoral arteriovenous aneurism, and subsided in a few hours. In one of these the pulse rose suddenly from 110 to 200 beats per minute. He gives no reason for this other than "the disturbed balance of the circulation brought about by closure of the fistula."

Holman has observed clinically and proved experimentally that one of the main adjustments following the formation of an arteriovenous fistula is a definite, though gradual increase in the total blood volume. It is to this increase in the fluid content of the blood that he ascribes Brianham's phenomenon and the heightened blood pressure which gradually returns to normal after excision of the fistula. He was able to demonstrate on the dog both the increase and, after the repair of the fistula, the gradual decrease in the total blood volume.

It is conceivable that in our patient the sudden changing, by excision of the fistula, of the habits and routine, as it were, of the heart for ten years past, might entail an abrupt and very considerable readjustment of that organ to the new conditions. Immediately on closure of the fistula it was noted that the pulse dropped to 40 and that the femoral artery increased in size by one-half. At this time there was probably also a temporary dilatation of the heart, sufficient to cause definite damage to the myocardium. This damage was not sufficient to make any difference while the patient remained in the hospital in bed, but when more activity was undertaken the still damaged myocardium was manifested by signs of decompensation. The gradual recovery also suggests this possibility. The increased blood volume above mentioned, though a factor in causing the myocardial injury, was probably gone on the third day when the blood-pressure returned to normal.

### SUMMARY

A case of arteriovenous fistula of the femoral artery and vein is presented, showing

(1) Brianham's sign and associated blood-pressure variations, due to an increase in blood volume caused by the fistula

(2) Cardiac dilatation and hypertrophy—the result of increased volume flow through the heart incident to the production of the fistula

(3) Slight dilatation of the proximal artery—due to the small size of the fistulous opening as compared to the cross-section of the artery

(4) Marked development of the collateral circulation following formation of the fistula



(5) Unusual occurrence of auricular fibrillation three weeks after operation, ascribed to failure of the heart following damage to the myocardium at the time of repair of the fistula

REFERENCES

- <sup>1</sup> Callander, C L Study of Arteriovenous Fistula with an Analysis of 447 Cases, Johns Hopkins Hosp Repts, 1920 vol xix
- <sup>2</sup> Holman, E The Physiology of an Arteriovenous Fistula Archives of Surgery, July, 1923
- <sup>3</sup> Holman, E Experimental Studies in Arteriovenous Fistulas, Archives of Surgery, Nov, 1924, Part II
- <sup>4</sup> Matas, R Arteriovenous Fistule, Southern Surgical Transactions, vol xxxvi, 1923
- <sup>5</sup> Reid, Mont R The Effect of Arteriovenous Fistula upon the Heart and Blood-vessels An Experimental and Clinical Study Johns Hopkins Hosp Bull, 1920, No 348 vol xxi

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting Held April 6, 1925*

DR EDWARD B HODGE, the President, in the Chair

## BULLET PERFORATING VENTRICLE OF HEART AND MIGRATING BY WAY OF ARTERIAL CIRCULATION TO SUPERFICIAL FEMORAL ARTERY

DR JOHN H JOPSON presented a colored man, aged thirty-nine years, who was admitted to the Polyclinic Hospital, August 28, 1924, on account of a gunshot wound of the chest just received at close range. He was a large, well-developed and well-nourished man in a moderate state of shock. There was a gunshot wound of the left thorax, the bullet entering at the third inter-space, about one and one-half inches from the midline of the sternum. No point of exit could be found. There was a slight sanguinous discharge from the wound. Respirations were dyspnoeic in character. His lungs revealed nothing abnormal. The heart rate was somewhat increased but was regular. The cardiac sounds were distinct. No murmurs were heard. There was no evidence of hypertrophy. The abdomen and extremities were grossly negative. He complained of some pain in the right leg. Wassermann was negative. Urine was negative.

He was given treatment for shock and then placed in Fowler's position with enough morphia to insure rest. A roentgenogram was taken in an endeavor to localize the bullet, but no signs of foreign body in the left chest could be detected. There was a density, throughout the whole left chest about the consistency of the liver, which suggested fluid. The temperature was 103.2, pulse 120, respiration 40. There was slight cough but no bloody expectoration. Aspiration of the left pleural cavity on two occasions resulted in a dry tap. A re-ray of his chest on September 5, again failed to demonstrate any evidence of foreign body. The opacity in the left chest, resembling fluid was still present. As the patient complained of pain in the right lower leg, an X-ray was taken of the right tibia and fibula. This was reported negative.

Further roentgenographic study on October 10 disclosed many fibrous adhesions in the left chest. These were thought to be due to old exudate or blood, which had been absorbed. There was an adhesion of the left diaphragm but no foreign body was detected. The patient was transferred to the Medico-Chirurgical Hospital on October 13, for further study. His temperature still remained elevated and a roentgenogram taken on December 2 was reported as follows. No evidence of effusion at this date. Still abnormal widening in the mediastinal shadow. A bullet was detected at right thigh, internal mid-region.

On December 16, the bullet was localized by fluoroscope. It was situated in the right thigh, at the junction of the middle and lower thirds, on the inside of the femur. At this time all chest symptoms had practically disappeared. He had a slight elevation of temperature, which was apparently due to a cellulitis and abscess of the right leg, on the outer side, about the middle third.

There was an absence of pulsation in the right popliteal and anterior and posterior tibial arteries. There was no swelling or other evidence of defective circulation in the limb except this absence of pulsation in the arteries.

A review of the history and study of the X-rays, and of the fluoroscopic findings apparently show that the bullet of 38 calibre, had entered the pre-cordial region, had perforated the pericardium and entered, either the aorta, which was most probable from the situation of the wound, or the upper portion of the left ventricle and was swept at once into the arterial circulation, finally lodging in and plugging the right superficial femoral artery in the upper portion of Hunter's canal.

The collateral circulation had taken care of the nutrition of the limb below. Further study of the X-ray plates, along with the history led to the belief that the shadow in the left chest was due to a large hemorrhage into the pericardium although this has not been verified by repeated careful examinations by the physicians who saw him in consultation at the Polyclinic Hospital.

Aspiration of the right lower leg showed the presence of pus and a free incision was made in the outer side, middle third, and a considerable collection evacuated beneath the deep fascia and dissecting between the extensor muscles. Dakin's tubes were inserted two days later and active dakinization of the wound was begun. There was rapid improvement and the patient was discharged on November 4 with instructions to report to the dispensary for daily dressings. On November 12, he had some pain in the line of incision. The wound was incised and a quantity of pus was evacuated. He was readmitted to the hospital on November 15 for a more complete incision of the infected leg. His temperature at the time of re-admission, was 90 pulse 110, respirations 24. An incision and drainage of the abscess was made on November 17 and the wound was again actively dakinized. Temperature remained slightly elevated until December 14 when it rose to 102°. Aspiration revealed the presence of a pus pocket in the same region. This was incised and drained on December 19.

Incision and drainage of pus pockets were again made on January 21 and January 31 1925. The pulsation in the vessels returned several weeks after his transfer to the Medico-Chirurgical Hospital. He has been very ill from time to time from relapsing infection of the leg cultures from which showed non-hæmolytic streptococci. At no time has there been any local reaction at the site of the bullet and for this reason, no attempt to remove it was considered indicated. It is quite possible, however that the infection travelled downward from the site of the bullet, as there was absolutely no portal of entry elsewhere as determined by repeated, exhaustive examinations by Doctors Rothschild and Fariell.

Examples of the entrance of foreign bodies bullets or shell fragments into the circulation while rare, have been noted with increasing frequency since the introduction of the X-ray and especially since the last war. Matas in his article on Military Surgery of the Vascular System volume vii *Keen's Surgery* gives a highly interesting resume of the subject.

The cases may be divided into two general classes.

I Those in which the foreign body enters the left heart and is carried through the aorta into the smaller arteries, being arrested at a point, where the lumen of the artery becomes too small to permit further passage.

Matas refers to six cases of this type, the oldest one reported in 1837.

II Cases in which the foreign body enters a vein and progresses from the periphery to the right heart. Reaching the auricles it may remain there, or progress further through the pulmonary artery to the lung, or it may pursue

## ACUTE DILATATION OF THE STOMACH

a reversed course from the right chambers into the venous circulation against the current. Those cases, migrating with the circulation, naturally exceed in number those migrating against the current. They may even enter the pulmonary artery and travel against the current into the right heart.

## ACUTE DILATATION OF THE STOMACH AND TETANOID CONVULSIONS FOLLOWING OPERATION FOR HERNIA

DR JOHN H. JOPSON presented a man, aged thirty-seven, who was admitted to the Medico-Chi Hospital, February 1, 1925, for operation for a large right scrotal hernia. He was a well-nourished, rather stockily built man.

Operation was performed by Doctor Jopson, February 2, and a complete, indirect, inguinal hernia was found with the major portion of the small intestine in the sac. Radical cure was effected by the Stetten modification of the Bassini method.

The patient reacted well from the anaesthesia and slept the greater part of the day, vomiting once that evening. He had a fairly good night but was nauseated and vomiting the following morning. Temperature was 100.2, pulse 110, respiration 28. Gastric lavage was administered, but the vomiting continued and a Jutte tube was inserted through the nostril into the stomach and fixed in place with adhesive for constant drainage. The material obtained from the stomach consisted of dark brown, granular appearing fluid. The abdomen was somewhat distended and hiccoughing occurred at short intervals. Twenty-five minims of ether were given intramuscularly for the hiccoughs. The Jutte tube continued to drain this dark brown material, but as the fluid became clear, the tube was removed from the stomach. One thousand c.c. of normal saline solution were given per hypodermoclysis.

Vomiting again occurred and the tube was re-inserted into the stomach. Hiccoughing still continued and the abdomen remained somewhat distended. Asafætida enemas were given to relieve this condition and were effectual. The fourth day after operation, the patient's condition was decidedly worse. He became delirious, cried out at intervals and began to have convulsive seizures accompanied by cyanosis and unconsciousness. These convulsions occurred at three-minute intervals and began as follows. The eyes would roll upwards and the pupils became dilated and would not react to light. Twitching started about the mouth, extending over the face, and the arms were raised and held up in tonic contractions. The hands were flexed at the wrists, but the typical tetanoid position was not observed. The respirations were rapid at first, and then held for ten to fifteen seconds in full inspiration. Nearly all of the body muscles appeared to be affected, the abdominal muscles became taut and the head was slightly extended. The leg and thigh muscles appeared to be only slightly affected.

The patient was extremely cyanosed with each attack and the fingers and hands remained somewhat cyanotic following each seizure. Oxygen inhalations were given, with the idea of combating the extreme cyanosis and appeared to have a decided effect in checking the convulsions. When the inhalations were stopped, the convulsions would recur, and in consequence the tube from the oxygen tank was placed in the nostril and held there with strips. His temperature was 101, pulse 120, respiration 24.

The urine was acid in reaction and was otherwise normal. The blood picture showed 3,530,000 red cells, 9300 whites, and 70 per cent hæmoglobin, 10 small lymphocytes, 4 large lymphocytes and 86 polymorphonuclears. The blood sugar was 149, creatinine 1.5, uric acid 4.1, urea 47, bicarbonate  $\text{CO}_2$  88 per cent, and calcium 12 mgms. It was unfortunate that an estimation of

the blood chlorides was not made. Glucose solution was given per rectum but was expelled. The sixth day following operation, the patient began to improve and retained small amounts of nourishment given by mouth. Two thousand c c of normal saline were given per hypodermoclysis.

Convulsions again began to recur, coincident with the supply in the oxygen tank running out, but when the oxygen inhalations were renewed, the convulsions again ceased. There was incontinence of urine and feces. The oxygen tube was removed on the seventh day, but the patient continued to have slight convulsions until the twelfth day following operation. Hiccoughing also occurred at intervals up to this time. During the course of his treatment he was given 8000 c c of normal saline solution per hypodermoclysis, also calcium chloride, ten grains intravenously for three doses.

A review of the history and symptoms in this case suggests that it is an example of the group of cases which are at present designated as cases of alkalosis. It corresponds in many respects to those which have been reported rather frequently in the recent literature under this name.

The sequence was as follows. A very large hernia which was reduced with considerable difficulty because of the many coils of small intestine in the sac, acute dilatation of the stomach which required prolonged drainage, generalized convulsions, but which were not particularly of the tetany type, accompanied by delirium, loss of consciousness and marked cyanosis, a high bicarbonate  $\text{CO}_2$  content of the blood plasma.

This condition has been attributed by some to rapid extraction of the HCl from the economy through the gastric juice. It, perhaps, furnishes a warning against the too prolonged use of the Jutte tube in cases of acute dilatation of the stomach, in intestinal obstruction and peritonitis. We have used the Jutte tube very frequently and have been enthusiastic over the results obtained in the class of cases mentioned. We have also noted in one or two other cases, what we thought were slight unfavorable symptoms from the very thorough drainage which it affords. These might have been due to dehydration. We have never seen such symptoms approach the danger line before.

It has been stated in recent literature that a ketonuria was observed in certain tetanoid conditions, ascribed to an alkalosis, because of the high bicarbonate  $\text{CO}_2$  content of the blood plasma. This should emphasize the necessity of a thorough study of the blood chemistry, particularly with reference to the bicarbonate  $\text{CO}_2$  content, in these cases, as the condition may otherwise be considered an acidosis and the wrong treatment instituted.

#### OPEN OPERATION IN AN ADULT FOR IRREDUCIBLE FRACTURE-DISLOCATION OF THE HIP

DR JOHN H. JOPSON described the history of a man, aged fifty-two, who was brought into the Polyclinic Hospital, November 11, 1924 with a history of having been injured in a street car accident. While getting off a street car the car started, before he had alighted, throwing him to the ground and dragging him across the street. When admitted he was in a state of shock. His head and neck were negative except for a slight laceration of the nose. A few wheezing râles were heard on inspiration over both lungs. There was no cardiac enlargement and no murmurs were heard. His left leg showed limitation of motion at the left hip. The thigh was adducted and internally rotated and there was about  $2\frac{1}{2}$  inches of shortening. There was considerable swelling and ecchymosis about the hip and thigh. The right leg was normal.

A roentgenogram showed the left femoral head dislocated upwards, and

## OPEN OPERATION FOR FRACTURE-DISLOCATION OF HIP

apparently backwards. There also seem to be small fragments of bone present, which may be due to fracture. The neck seems normal.

Reduction was then attempted by Doctor Rothschild under ether anaesthesia, but was unsuccessful, and a Buck's extension was temporarily applied with sixteen pounds of traction.

Reduction was again attempted by Doctors Willard and Rothschild on December 2, but was unsuccessful. Rontgenographic examination at this time, showed that the head of the femur was displaced upward and posteriorly from the acetabular cavity, and that there was a fragment of bone, probably from the head, in the acetabular area.

December 7, he was transferred to the Medico-Chi Hospital, where reduction under anaesthesia was again attempted by Doctor Jopson but without success. Twenty pounds of traction with Buck's extension was then maintained until December 23, when open operation was performed by Doctors Jopson, Willard and Rothschild. The anterior aspect of the capsule was exposed by a sub-periosteal elevation of the glutei muscles. The capsule was opened by an anterior, external vertical incision and three fragments of bone, broken from the head, were removed. Two of the fragments were about 2 cm. in diameter and were lying comparatively free and covered by cartilage. The third fragment, about  $4 \times 2\frac{1}{2}$  cm. in diameter, was included in the capsule. The rectus tendon was divided to facilitate exposure and reduction. The head of the bone was further exposed by retraction of the glutei. Doctor Willard then manipulated by the Bigelow method, with Doctor Jopson directly manipulating the head with skids. Two other assistants made forward pressure over the trochanter. The upper undivided fragment of capsule acted as a hamstring and had to be cut.

The head was brought to the posterior edge of the acetabulum by adduction and flexion and upward traction on the knee. The edge of the acetabulum resisted re-position until further downward traction on the leg and further forward pressure on the trochanter, caused the head to slip into the acetabulum. Three or four small vessels were tied and the capsule was sutured with interrupted chromic catgut stitches. The large wound was approximated with buried catgut and superficial sutures of silkworm gut. A large, fenestrated, split rubber tube was placed in the posterior part of the wound for drainage and a long padded board splint was applied to the trunk and leg.

The operation was well borne. There was moderate shock and camphor and strychnia were given for stimulation. The patient reacted well from the operation and from anaesthesia. On the following day his condition was good. There was a slight discharge of sero-sanguinous fluid from the incision. The drainage tube was removed on the sixth day. Sutures were removed on the eighth. The patient had no further pain in the hip and a re-X-ray showed perfect reduction. Extension was maintained for three weeks, reducing the weight gradually. He began to complain of severe pain in the posterior part of the left knee on the twelfth day. This condition was believed to be due to a "splint arthritis." The board splint was removed and a Thomas splint, with an attached leg piece, hooked up to a Balkan frame, was then used to permit exercise of the knee.

The patient was forced out of bed on the forty-first day (it was difficult to secure his cooperation) and massage treatment was instituted. At the present time he is able to be about on crutches. He has some oedema of the leg and foot, which is lessening and the knee motion is slowly improving. There is a slight ulceration of the heel. Hip motion is fairly good.

DR DEFOREST P WILLARD remarked that the incision used in this case is one suggested by Dr M N Smith-Petersen, of Boston, and is known by his name. It is used almost routinely in orthopædic surgery for exposure of the hip-joint. It consists of a reversed L-shaped incision beginning at the level of the lower border of the hip-joint, extending upwards along the outer edge of the rectus muscles to the anterior superior spine, then backwards for about four or five inches just below the iliac crest. Tensor fascia femoris and gluteal muscles are resected backwards and downwards sub-periosteally until the acetabular cavity is reached. The capsule can be opened either by incision along the neck of the femur or along the edge of the acetabulum. This incision gives excellent exposure to the hip-joint, and in such a case as that presented by Doctor Jopson, it is the only type through which results could be obtained.

DOCTOR JOPSON added that the result in this case still leaves much to be desired. The man is not young and they hesitated before resorting to the open method but felt it was justified by his condition as he was hopelessly crippled. It was largely due to the wisdom and assistance of Doctor Willard that the operation was carried through and the reduction obtained. It took the combined efforts of four surgeons to lift the head over the posterior portion of the acetabulum. The exposure was ample. It has been difficult to get the cooperation of this patient and he is very easily discouraged, so much so that at times it has seemed as if we were making progress backward rather than forward. In describing the motion in the joint as fair, it is meant that it was about 20 per cent. He is still in the hospital, and under treatment by massage, etc.

DR A P C ASHURST said that a good many years ago he assisted Doctor Harte at the Orthopædic Hospital in operating on a patient of this type. Doctor Harte excised the head of the femur and though this seemed rather radical treatment, the result was extremely satisfactory. The patient was above fifty years of age, he secured free motion, without pain, though of course with limp. The man returned to work and now is living on a ranch, he has been able to ride horseback and do just what he wants to for the last fifteen or eighteen years. Excision of the hip is a comparatively easy operation and it seems to have certain advantages, especially in elderly patients over open reduction of the dislocation, which may give a very prolonged convalescence, and leave the patient with a stiff and painful joint.

#### PERSISTENT FECAL FISTULA TREATED BY ILEO-CÆCAL RESECTION AND ILEO-COLOSTOMY

DR JOHN H JOPSON presented a man, aged forty-six, who was admitted to the Medico-Chirurgical Hospital, February 9, 1925, for study and possible operation for a fecal fistula. Previous to an attack of appendicitis in 1905, he had always been unusually healthy. Since that date he had had thirteen operations, the first two for suppurative appendicitis and the remainder for fecal fistula.

At the time of his original operation for an acute appendicitis, a few days

## PERSISTENT FECAL FISTULA

later his abdomen was reopened to institute drainage. This was followed by an incisional hernia and a fecal fistula. He had several operations during the following years for adhesions. Operation again followed for incisional hernia and fecal fistula. This operation was unsuccessful and he had a two-stage operation performed in Rochester, Minnesota, for the cure of his hernia and fistula. The following year, he had a recurrence of the hernia with strangulation and was again operated, but had a recurrence of his fistula.

Two years later he had a further operation for adhesions, with good results, and his fistula closed for about two years. Three years ago there was a recurrence of the hernia, with strangulation, and he was re-operated. Four days after this operation, the wound broke down, with reformation of the fistula. The wound remained open for seventeen weeks, when an attempt at closure was made. Shortly afterwards, he noticed an opening in the incision, through which gas and feces escaped. Four months ago, there was a prolapse of the bowel through the fistulous opening and this occurs constantly.

The patient stated that when he was able to keep the bowel in the abdomen, he passed feces through the rectum, but when the bowel protruded, all of his feces passed through the fistula. His abdomen was rather obese and showed an operation scar, extending diagonally (about  $30^\circ$ ) from the pelvis to the costal margin, spreading to a width of two inches over McBurney's point.

At the widest portion of the scar, there was an opening lined with mucous membrane, about 1 cm in diameter, through which the bowel prolapsed for about three inches. The length of the prolapsed gut sometimes was considerably greater. Feces exuded through the opening.

Serial roentgenographic films made of the colon, outlined with barium, at the 15 and 24 hours in succession, revealed no X-ray evidence of fistula extending between any portion of the bowel, with special reference to the pelvic colon, nor into the peritoneal cavity. The cæcum was fairly, freely movable. The fistula was approximately 4 cm above the cæcal tip. An opaque enema confirmed the above observation. This examination was made to determine whether any short-circuiting or resecting operations had been previously performed.

In a following study, barium was injected immediately through the fistula and, apparently, communication was directly into the cæcum. A plate was made fifteen hours later to determine if the bismuth moved with the normal colon channel, or if it was loculated. Subsequent examination showed that the bismuth was not loculated but was apparently free in the colon.

Under general anæsthesia, the fistula was first dissected free, down to the peritoneum and closed with a suture ligature. The peritoneal cavity was then opened and the fistulous opening, one cm in diameter, and the bowel which prolapsed through it, was located in the cæcum. About three inches of the terminal ileum was then resected, together with the cæcum and the first part of the ascending colon. A lateral anastomosis between the ileum and ascending colon was made, and the defect in the abdominal wall, including a large incisional hernia, was repaired by layer suture. A cigarette drain was placed in the abdomen, down to the point of anastomosis. One thousand c.c. of normal saline solution were given per hypodermoclysis, during the operation, and camphor and digalen were given for stimulation. The patient reacted well, and his condition was good on the following day.

There was a slight serous discharge from the incision. The drain was removed on the third day. Three days after operation he had a liquid stool containing blood clots and some free blood. The wound healed by first



intention, with the exception of a small opening, through which drainage was established. This area gradually filled in with granulation tissue. His convalescence was uneventful. He was troubled for a few days with a persistent diarrhoea. His wound has solidly healed.

The temptation was great to close the small opening in the caecum and drop it back without resection, but the caecum had probably been shortened by repeated suture operations and resection of the atrophied margins of the opening. The necessary inversion would have brought the suture line very close to the ileocaecal junction. The bowel wall was very thin at this point.

For this reason, and in view of the failure of repeated operations of the conservative type at the hands of skilful surgeons, determined the decision to resect the entire caecal area.

#### RHINOPLASTY

DR GEORGE M. DORRANCE presented a young woman to show progress in the construction of a new nose for which his "peak roof" method had been used. He considered the result satisfactory. The girl has a fairly good-looking nose, through which she can breathe freely.

#### POST-APPENDECTOMY PYLEPHLEBITIS, WITH LIVER ABSCESS

DR E. L. ELIASON reported the history of a boy thirteen years of age, who was operated upon by him at the University Hospital for a ruptured gangrenous appendix. A spreading peritonitis had already developed. Drainage was instituted, and the usual technic for peritonitis inaugurated including an intravenous injection of 5 per cent solution of gentian violet. The temperature dropped to normal on the third day, but fluctuated during subsequent days. On the ninth day a slight chill was felt. Temperature rose to 102. During the immediately following days evidences were noted of congestion in the right diaphragmatic region.

On the eighteenth day following operation it was noted that rigidity was present in the upper right abdomen. Tenderness to fist percussion over the liver. A very slight oedema was noted in the mid-axillary line extending over the eighth, ninth and tenth ribs. There seemed to be a slight engorgement of the superficial veins in this area. Palpation of the abdomen elicited a thick, irregular, doughy feeling. No fluid could be demonstrated in the flanks. Vidal haemoclastic crisis test indicated a reduction in hepatic function and an intra-hepatic collection was suspected clinically in the right lobe although the X-ray revealed a high fixed diaphragm on this side. A needle was introduced in the anterior axillary line between the ninth and tenth ribs. It was directed downward into the liver and pus was withdrawn. Resection of a piece of the ninth rib was performed. The parietal pleura was stitched to the diaphragm around the needle which was left *in situ*. An actual cautery was then passed down along the needle and an opening the size of one's thumb cauterized into the abscess cavity which contained from two to three ounces of thick yellow pus. The patient's temperature promptly dropped to normal and remained there. A bismuth preparation was injected into the abscess cavity, which X-ray plates revealed to be within the liver. The patient made a subsequently uneventful recovery and left the hospital just one month from the day of admission.

DR CHARLES F. NASSAU remarked that in cases of death from an appendix case in which secondary liver abscess had formed, it was the rule to find at necropsy, that the septic condition of the liver started with multiple

## DIVERTICULA OF THE JEJUNUM

abscesses, which rarely break down to single abscesses before death. This is obvious to those who have had subphrenic abscess cases which were diagnosed as liver abscesses, the differential diagnosis being extremely difficult. If the abscess is amœbic, the formation of a single abscess is probable.

DR A P C ASHHURST favored the suggestion of Doctor Nassau that Doctor Eliason's case is one of subphrenic rather than of hepatic abscess. In 1900, Loison, a French surgeon, reported 12 fatal cases, and one recovery, after operation for hepatic abscess following appendicitis, but in the discussion of this report Tuffier said that he thought the facts presented were not sufficient to justify the diagnosis, and that the cases reported were instances of subphrenic abscess. Even before that date, however, Loison pointed out that Korte, in 1892, had recorded a successful operation for an abscess of the liver secondary to appendicitis. Moreover, in 1911, Quénu and Mathieu collected reports of operations on 14 such patients, with only 2 deaths, they said that in these very exceptional cases of operation for this complication of appendicitis, either single abscesses had been present in the right lobe of the liver, or, that multiple abscesses had fused or were readily drained through a single opening. So that it must be admitted that such cases though rare, may occur. But in Doctor Eliason's case the facts he has so far mentioned in his brief verbal report of the operation leave the exact situation of the abscess in doubt.

DOCTOR ELIASON rejoined that this abscess was in the liver. When the chest was opened near the lower end of the pleura, he could see when he opened into the diaphragm that the liver was free underneath it. The abscess was in the liver substance one inch away from the diaphragm, also the X-ray and the use of the bismuth preparation proved this was so. He had had two other cases in the last year that looked like simple single liver abscess, both of which were diagnosed liver abscess, and at operation an abscess in the lower surface of the liver was opened and drained. Unfortunately neither one of these cases was post-mortemed, so they may have had other abscesses as stated by Doctor Nassau.

---

## LENGTHENING THE SOFT PALATE IN OPERATIONS FOR CLEFT PALATE

DR GEORGE M DORRANCE read a paper with the above title, for which see page 208.

## DIVERTICULA OF THE JEJUNUM

DR NORMAN P ROTHSCHILD (by invitation) read a paper with the above title, for which see page 250.

## CORRESPONDENCE

### CURE OF INTESTINAL FISTULA NEAR THE DUODENO-JEJUNAL JUNCTION

EDITOR ANNALS OF SURGERY

Sir,

In an intestinal fistula, not far from the duodeno-jejunal junction, besides the difficulties encountered in keeping the skin surface in the neighborhood of its external orifice free from the excoriations attendant upon the discharge of contents rich in digestive juices, there is also the more serious problem of maintaining nutrition in the face of a continuous escape of ingesta before any appreciable amount of absorption can occur. Frequent changes of dressings fail to keep the wound clean. The application of protective pastes to the skin surface are of little value. In a comparatively short while the skin exhibits an angry, red, excoriated appearance which becomes progressively worse. As a direct result of the presence of the gastric intestinal, biliary and pancreatic secretions in the discharge, there is no tendency towards spontaneous healing, the usual course being rather progressive enlargement of the fistula.

Frequently, complicating the fistula, or responsible for it is a local sepsis of variable extent and virulence. The presence of infection diminishes the expectation of the success of any radical operative procedure to close the fistula. The patient rapidly loses weight, becomes progressively weaker as a result of inanition, and in a very short while, if no check to the progress of the debility can be instituted, the physical condition is so poor that even with the sepsis controlled, any operative risk is exceedingly hazardous.

Rectal feeding and intravenous administration of glucose are of little value. The establishment of an enterostomy below the fistula through which nutrition can be maintained is much more valuable. The most effective means for combating the progress of inanition is unquestionably restitution of the continuity of the intestinal tract. In illustration of how this may, in some cases, at least, be quickly accomplished, even in the face of considerable infection, the following case is reported. A woman, aged forty-six years, was admitted to the Brownsville and East New York Hospital, January 6, 1923, complaining of severe abdominal cramps, vomiting and a protruding umbilical hernia which had been present for six years. Symptoms of strangulation had been present for about twelve hours. She was very obese, weighing 230 pounds. Upon operation the contents of the sac were found to be chiefly omentum (very fatty) and intestines one loop of which was blue black, but peristalsis soon returned in this after the constricting ring had been divided. A mass of gangrenous omentum was excised. The operation was concluded with a Mayo hernioplasty and closure without drainage.

## CORRESPONDENCE

The patient was returned from the operating room in good condition and ran an ordinary post-operative course for the first six days. Then suddenly she became cyanotic, dyspnoëic, incontinent and developed moist râles all over the chest. The heart showed signs of dilatation. Digitalis and atropine controlled the condition, the chest signs receded and the patient again became comfortable. The temperature on the twelfth day, however, began exhibiting a fluctuation which continued daily, ranging from  $99^{\circ}$  in the morning to  $102-103^{\circ}$  in the evening. The wound was clean. On the sixteenth day a hard, indurated mass began making its appearance in the median line of the abdomen, about two inches above the level of the operative wound. It was very tender but not fluctuant. The mass persisted, becoming gradually more superficial. Finally on the twenty-fourth day after operation the patient had a severe chill lasting fifteen minutes and the temperature rose to  $105^{\circ}$ . She was taken to the operating room and a vertical incision made in the median line beginning 3 inches above the original horizontal incision and extending down to it, incising through at least 4 inches of fat to the fascia and after that, into a large cavity containing approximately one-half pint of sero-purulent fluid. After the fluid was evacuated, material which had the appearance of intestinal content was discharged in little gushes from the bottom of the cavity. Cigarette drainage was instituted and the patient returned to bed. The following day there was no difficulty in recognizing that an intestinal fistula was responsible for the discharge. Charcoal was found in the discharge, fifteen minutes after ingestion, which indicated that the intestinal lesion was not far below the duodeno-jejunal junction. The patient continued to run a mildly septic course, continued discharging all ingesta and began exhibiting an exceedingly rapid loss of weight. Rectal feeding was apparently of no value. The patient could be seen to be losing weight daily.

After nine days of ineffectual temporizing the base of the wound was thoroughly explored and the proximal and distal limbs of the fistulous loop located. A piece of glass tubing was bent into a horseshoe shape to conform to the angulation necessary to bridge the gap between the lumen of the two loops without placing undue tension on their walls. Short pieces of rubber tubing were attached to the limbs of this glass tube. The free end of one was inserted into the proximal loop and the free end of the other into the distal loop. There was then a patent artificial bridge across the gap between the fistulous loops. This bridge lay at the bottom of the wound, now about three inches from the skin surface. To diminish leakage, zinc oxide ointment was spread around the connections and the wound tightly strapped over a gauze sponge.

It was quickly noted that the drainage diminished, bi-daily dressings being now sufficient. Intestinal contents were absent from the discharge which assumed a definite purulent character. An enema given the day following the introduction of the bridging-tube showed formed feces in the return

This was the first effectual return of any enema given since the development of the fistula

From then on, there was a rapid general improvement in the condition of the patient. The temperature declined to normal, the discharge from the wound kept diminishing, and the wound surfaces began granulating in. Nutrition rapidly improved, the loss in weight ceased, and health and strength began returning.

Granulations filled in the space between the arms of the glass tube and began growing over its external surface. On the twenty-fifth day after the introduction of the glass tube the granulations had grown so profusely around the bridge that it was withdrawn with considerable difficulty. The skin edges were firmly approximated by adhesive strapping and the upper part of the wound closed in rapidly, leaving a patent canal between the two loops through which there continued the unobstructed passage of intestinal content. On the 11th day of March the patient was discharged with a healed wound, sixty-five days after admission, forty-one days after the establishment of the fistula and thirty-one days after the introduction of the glass bridging-tube.

On examination two weeks after discharge, her general health was improved, and her weight had increased. She had a large ventral hernia for which a support was prescribed. Her general health has been uniformly good with the exception of an attack of severe abdominal cramps accompanied by constipation and vomiting which occurred in January, 1925. The impression was that the condition was one of acute intestinal obstruction because associated with the subjective signs was a small mass in the region of the healed fistula, and visible peristaltic movements. However, colonic irrigations and enemata gave relief and operation was deferred.

The intestinal fistula developed, probably as the result of subsequent ulceration and necrosis of the incarcerated loop which at operation had been judged to have been viable. The fistula was high up in the intestinal tract the discharges were very irritating. The artificial bridging of the intestinal tract was intended as a temporary, manition-relief measure to be used only until the sepsis would diminish and the patient would become a better operative risk. The results were so gratifying and the improvement so progressive that by the described modification of the original plan the fistula was healed without resort to further surgery.

HARRY KOSTER, M D ,  
*Brooklyn, N Y*

### TORSION OF THE GREAT OMENTUM

EDITOR ANNALS OF SURGERY

Sir

UP to 1915, one hundred and thirty-one cases of torsion of the great omentum were found by Bookman to be recorded in the literature

There is no pathognomonic sign or symptom by which such a condition can be recognized with certainty. The suggestive symptoms, if one has this condition in mind, are vague abdominal pains, aggravated by exertion, relieved by rest, a feeling of an indistinct mass moving about in the abdomen, nausea or vomiting, occurring in the middle aged. In view of the vagueness and uncertainty of the symptoms attending this condition a report of another carefully observed case may be instructive.

CASE REPORT—A C, male, age twenty-eight years. Was never sick before in his life except for a few attacks in the past year of vague abdominal pains, which would last for about an hour or less.

Present complaint, May 31, 1925, on rising he complained of vague abdominal pain, but he went for a boat-ride for the entire day. He ate little while on the boat because of the abdominal discomfort. The discomfort and pain were aggravated while he was walking about, but would be relieved while sitting down. He returned home at 11 P M and took a bottle of magnesia, after which he vomited twice. During the night he complained a few times of some pain. When he arose in the morning he began to complain of severe abdominal pain and some nausea. Pain was at first in the upper part of the abdomen, and in the course of a few hours shifted down below the umbilicus and to the right. At 2 P M when first seen by the writer in consultation, his pulse was 110, temperature  $100\frac{1}{2}$ , respiration 28. Blood and urine examination negative. Abdomen rigid and tender all over but more marked and board-like over the upper right rectus. No particular tenderness over McBurney's point. A right indirect inguinal hernia with a ring, admitting two fingers. Impulse on coughing, sac small size. Right testicle could not be found in scrotum or elsewhere.

The patient was admitted to the United Israel Zion Hospital and operated on by the writer June 1, 33 hours following the onset.

Through a right rectus incision the peritoneum was exposed, was found to be oedematous and of dark color, when opened, copious bloody fluid escaped. The omentum presented itself at the wound and was of a brawny purplish color. The incision was enlarged upwards and the hand was introduced into the abdominal cavity. A mass the size of a large fist could be felt just below the stomach. The mass was continuous with the presenting omentum. The condition was then recognized as torsion of the large omentum. When the mass was delivered, it was found to consist of the omentum twisted on itself six times. The proximal upper half was strangulated, oedematous and about two inches in thickness, black in color. Clamps were applied at that margin and omentum excised. Separate ligatures were used for the cut edge of the omentum so as to avoid kinking or twisting of the colon. Condition of patient remained good. The appendix was found thickened with a short meso and was removed. The testicle could not be felt intra-abdominally or in the inguinal canal. The omentum appeared at no time to be in any way adherent to the hernial sac. It was, however, elongated, which may have predisposed it to torsion. The abdomen was closed without drainage. It was not deemed advisable to repair the inguinal hernia at the same sitting. The patient had no complications and made an uneventful recovery. The torsion strangulation, thickening and swelling of the omentum was most marked in its proximal half. The distal half was free and could be readily untwisted. The veins in the distal portion were cord-like and the thickness of a lead pencil. The anterior and posterior layers of the omentum could readily be separated, clearly showing the lowest recess of the lesser peritoneal cavity. The entire large omentum was involved and removed. It measured about two feet in length, twelve inches in width. The proximal portion was about two inches in thickness.

JACOB SARNOFF, M D,  
Brooklyn, N Y

## NOTE ON THE TREATMENT OF ABDOMINAL SEPSIS

EDITOR ANNALS OF SURGERY

Sir

Excepting in some cases of tubercular peritonitis, I do not employ general irrigation during operation in septic abdominal conditions as I am possibly obsessed with the dread of diffusing septic elements. Instead I rely on thorough mopping up with large dry bibules. I then introduce two or three rolls of iodoform gauze which are carefully placed in the maximum septic zone. In abdominal infection it is most essential to provide ample room for free exit of secretion. I have for some years past been gradually forced to the conclusion that while we require large tunnels for efficient drainage of septic compound fractures, etc., we require an open chasm for effective drainage in intra-abdominal suppuration. I do not know of anything which has sent more people to a premature grave as the sense of security engendered in the surgeon by ill-considered, inefficient drainage not to add the ghastly error of expecting the ever-friendly peritoneum to do the impossible, *viz* to remove by absorption, toxic material from an abdomen of a body saturated with general septicæmia.

I am convinced that we should hear much less about the "wait and see until things settle down" (after the first twenty-four hours) treatment in appendicitis if surgeons would abandon the employment of drainage tubes in abdominal surgery and instead would substitute (a) leaving the parietal wound temporarily open, but introducing for its subsequent closure interrupted through-and-through double silkworm gut "waiting" sutures, knotting or ligating ends of same to prevent their slipping out, (b) then packing the septic cavity with rolls of gauze well wrung out in freshly prepared iodoform emulsion, and subject to the amount of peptonization leaving same in position for one to three days. After this when the flow of pus is established, dispensing with gauze packing and uniting as much of the parietal wound by the "waiting" sutures as may be reckoned judicious, *etc.* leaving sufficient (visible) opening for free drainage without if possible, entailing over-exposure of the adjacent intestines. I have found that in cases treated in this manner after the fourth day low level gentle irrigation of the septic space around which encircling protective adhesions as a rule, have by this time formed, with peroxide carbolic lotions, rapidly overcomes foetor and, in conjunction with perchloride of mercury fomentations, by the fourteenth day induces a clean granulating wound.

In abdominal surgery the question constantly arises shall I drain or not? Personally, I have not had occasion to regret having done so but now and then have had bitter reflections for its omission.

I am quite aware that leaving an abdomen open is not artistic surgery but am equally cognizant of the fact that closure of a peritoneal cavity in which there exists a reasonable possibility of subsequent sepsis arising is an unworthy act. I make it a rule in this contingency to pack a bibule into the suspect area while I insert the interrupted silkworm gut sutures and then

before partially closing the parietal wound an assistant retracts the edges of latter while I remove the bibule and introduce a stout wisp of silkworm gut, in plain sight, into the suspect fossa at a point corresponding to the site of the primary lesion. This I reckon a vital manœuvre, as I have seen, more than once, death follow the introduction of drains which did not touch much less drain the dangerous zone. It is easy to visualize that, if a coil of intestine or plug of omentum should intervene between the drain and the objective, if sepsis ensues, a tragedy is probable.

Tier sutures should not be employed to close the parietal wall in any suspect septic case. When the wisp is removed on the fifth or sixth day and sepsis has not taken place, the corresponding portion of wound is united by its "waiting" suture. I have frequently obtained prompt aseptic secondary union after such use of a wisp, but never after that of a rubber tube.

For promoting the aseptic union of abdominal parietal wounds, after the peritoneum has been closed by a continuous catgut suture, I place a six-strand wisp of silkworm gut between the peritoneal and rectal sheath layers. The rectal sheath is then similarly united, the ends of the wisp emerge at each angle, and similarly are made to extrude through the angles of sutured skin and subcutaneous layers.

We have been frequently surprised at the quantity of serum which subsequently exudes alongside of this wisp. So far it has materially assisted in the aseptic union of all wounds in which it has been tried. When the serous oozing ceases (sixth to tenth day) the wisp is removed.

JOHN O'CONOR, M.D.,  
*Buenos Aires, Argentina*



## BOOK REVIEWS

FRACTURES AND DISLOCATIONS, IMMEDIATE MANAGEMENT, AFTER-CARE AND CONVALESCENT TREATMENT WITH SPECIAL REFERENCE TO THE CONSERVATION AND RESTORATION OF FUNCTION By PHILIP D WILSON, Instructor in Orthopædic Surgery Harvard Medical School and WILLIAM A COCHRAN, University Tutor in Clinical Surgery, University of Edinburgh Octavo 806 pages Philadelphia and London, J B Lippincott Co, 1925

This is a well-written well-illustrated treatise on Fractures and Dislocations. The first three chapters are taken up with the principles of treatment emergency splinting and the treatment of compound fractures and dislocations. A wealth of practical information is contained in these pages. The authors have selected the best of the older methods, combed out the essential principles from the mass of war material, simplified them and made them accessible for civil practice. In doing this they have shown sound judgment. We believe that the value of these three chapters would have been enhanced by a note of warning on the dangers and drawbacks of the different forms of splinting employed for transportation of the wounded. As evacuation officer for the wounded of the First Army we had, unfortunately ample opportunity to realize that these dangers were not always appreciated. The advantages of the suspension treatment in suitable cases are well stated. Figure 4 illustrating the method of suspension in a "Balkan" frame although taken from the "Outline of Treatment of Fractures" Archives of Surgery, violates some of the essential points of traction and balanced suspension. In the legend and text we find the misnomer "Balkan Frame".

The body of the book is devoted to the treatment of the individual fractures and dislocations. The chapters open with a brief anatomical and physiological review of the region under consideration. The value of the review is increased by the well-selected anatomical plates and diagrams. Such knowledge is essential to the proper understanding of the problems connected with fractures. Without it the employment of traction and suspension in the physiological treatment of fractures is just an empty form of going "through the motions".

Chapters IV to IX are devoted to the upper extremity. The treatment advocated is practical, well balanced and based on the sound principles of prompt anatomical reposition and early functional use. Chapter IX on injuries of the wrist and hand contains a wealth of practical detail. The authors are liberal minded regarding the choice of position in the treatment of Colles' fracture. They employ the cock-up position in the cases where protection alone is needed, in displaced fractures without much comminution or without a tendency to recurrence a moderate palmar flexion, in the severe cases the Cotton-Loder position.

Chapters X to XII are devoted to the vertebral column and to the bones of

## BOOK REVIEWS

the face and thorax. The chapter on the vertebral column is a well-rounded exposition of a difficult subject. The chapters on injuries to the bones of the face are not very full, but the methods described are well within the ability of the general practitioner. It is to be regretted that fractures of the skull have been omitted, this we believe to be a mistake. The increasing number of automobile accidents occurring throughout the country has raised the incidence of these lesions in general practice.

Chapters XIII to XIX are devoted to the injuries of the pelvis and lower extremity. In the fractures of the neck of the femur the authors advocate the Whitman abduction method as the routine treatment. In the operative treatment of ununited fractures of the neck of the femur no mention is made of Albee's reconstruction operation. We believe this operation has given some excellent functional results and should be considered.

The section on the lower extremities is thorough and embodies the best surgical teaching of the day. Special attention has been paid to the after-care of these fractures and emphasis laid on the necessity of protection, maintenance of alignment and early functional use. Precise directions are given for the accomplishment of such results.

HENRY H M LYLE

**THE CRIPPLED HAND AND ARM.** A monograph on the Various Types of Deformities of the Hand and Arm as a result from Abnormal Development, Injuries and Disease, for the Use of the Practitioner and Surgeon. By CARL BECK, M.D. Octavo, 243 pages. Philadelphia and London J. B. Lippincott Co., 1925.

Comprehensive surgical treatises on the hand have appeared but rarely. There are numerous monographs on special subjects relating to the hand. Excellent as they are, there is an urgent need for a work like "The Crippled Hand and Arm." The hand is such a complicated organ and the functional and anatomical relationship of the structures are so intimate that it is rare to have but one structure involved in a disability. As a rule we have to deal with combinations rather than with individual lesions. This fact is the keynote of the value of Doctor Beck's work. He has coordinated the different methods of treatment and shown us how to handle combinations of lesions. The work is particularly rich in plastic restorations and contains many new and novel suggestions. A large portion of the book consists in a record of personal experience in solving the many intricate problems which arise in the reconstructive surgery of the hand. With very few exceptions the illustrations are original. They depict the surgical problem to be solved, the method of solving it and the result obtained. The majority of illustrations are photographs but numerous detailed drawings are inserted to show the surgical procedure.

HENRY H M LYLE

**APPLIED ANATOMY.** By GWILYM DAVIS, late Professor of Orthopædic Surgery, University of Pennsylvania. Revised by GEORGE P. MULLER, Professor of Clinical Surgery, University of Pennsylvania. Sixth edition,

octavo 638 pages Philadelphia, London and Montreal J B Lippincott Co, 1924

The surgical profession welcomes the appearance of a new edition of Davis' Applied Anatomy. This unique book has become to the surgeon what Gray's anatomy was to him in his student day—a guide and an ever-faithful helpmate. Professor Muller has carried out his revision so skilfully that none of the essentials of the former editions have been sacrificed. Although much new matter has been added the sixth edition contains only a few more pages than the fifth.

The additions consist chiefly in fuller descriptions of the modern surgical procedures and in the insertion of numerous helpful illustrations. The choice of the operations, their terse descriptions and sound advice makes this edition especially valuable. We believe that if every general practitioner would consult this work before witnessing an operation he would have a much better idea of the advantages and limitation of the different surgical procedures.

Beside maintaining the high standard of illustrations set by the former editions, many new and useful plates have been added.

We commend this excellent book to the student, the surgeon and the general practitioner. Within its covers each will find help in solving his individual anatomical and surgical problems.

HENRY H M LYLE

MODERN OPERATIVE SURGERY. Edited by H W CARSON, F.R.C.S. Senior Surgeon to the Prince of Wales' Hospital, Tottenham. London and New York, Cassell and Co. In two volumes, octavo.

In these two volumes Mr Carson has endeavored to present a description of modern operative procedures over the whole field of surgery including the special branches such as gynecology, the eye, ear and nose. He has been aided in the task by more than twenty surgeons writing upon those branches of the subject in which their names are household words. Throughout the book, an attempt has been made to confine the procedures described to those operations of proved value and general acceptance and others of classical interest only have been ruthlessly discarded.

The subject has been divided into chapters of varying scope, thus some deal with the surgery of one or other system, for example, the vascular system or joints, others with individual diseases such as cancer of the large bowel and appendicitis, and others again with single organs or anatomical regions, as, for instance the spleen, biliary passages and the neck. This arrangement, whilst appearing to lack method, has certainly allowed Mr Carson to make the best possible use of the special knowledge of his collaborators.

Mr Carson is to be specially congratulated upon the uniformity in style of the contributions from so many authors, a tribute to the care with which his editing has been done. In almost each chapter there is added to the description of the operations themselves useful information on the indications for the procedure, warnings as to special dangers and difficulties, some indi-

cation of results collected either from the authors' own statistics or those published by large surgical clinics

The printing and reproduction of the illustrations is excellent throughout, and the general style of the volumes gives them the appearance of companion books to the recent edition from the same publishers of Choyce's *System of Surgery*

Outside the immediate scope of the book there is a chapter on anæsthetics by Mr Blomfield which, if included at all, might well have been longer, and have dealt a little more fully with modern advances in local anæsthesia, one on "Conservative Treatment of Surgical Tuberculosis," by Sir Henry Gauvain, which certainly could ill be spared, and a third by Mr Sampson Handley on the "General Principles Underlying the Surgery of Malignant Disease"

Mr Elmslie writes on General Orthopedics, Operations on Tendons and on Amputations. He confines himself in the main to a description of actual operative technic, one is a little surprised to find that in the latter chapter he includes descriptions of such amputations as Chopart's and Lisfranc's, which hardly merit a place in a book which definitely sets out to discard the classical and retain only what is up to date

The chapter on fractures is contributed by Mr Hey Groves, he writes with his accustomed clearness descriptions of those operations for bolting and plating fractures, and their treatment by bone grafts which he has done so much to systematize. The numerous excellent illustrations add greatly to the usefulness of the text

Mr Richard Warren includes in his chapter on the surgery of the thorax, paragraphs on the treatment of injuries of the diaphragm, the treatment of diaphragmatic hernia and transpleural laparotomy

Mr Walton's first contribution is on operations on the spinal cord, one of the best illustrated in the book. He also contributes an excellent chapter on the Thyroid, and finally deals with the difficult conditions of Abdominal Ptois and Intestinal Stasis. Although he describes in detail the many operations which have been practised in recent years for the relief of these two conditions, he is very definite in his views as to their limited application, and the great care necessary in the selection of suitable cases. He suggests that many of the good results claimed are to be attributed more to the success of a striking line of treatment by suggestion than to the mechanical results effected

Mr Harry Platt contributes a chapter upon operation upon nerves, the value of which is greatly enhanced by the careful anatomical and pathological sections which he incorporates

Mr Sampson Handley writes upon surgery of the breast. The operation for carcinoma of this organ that he describes is based not alone upon his fundamental pathological work on this disease, but upon his very wide clinical experience and sets a very high standard indeed. To his safe hands is entrusted also a description of operations for Melanoma and

## BOOK REVIEWS

Rodent Ulcer, and here again one meets with the same thorough surgical application of pathological knowledge of the diseases in question

Mr Grey Turner contributes a most excellent chapter on the surgery of the liver and biliary passages, clearly written well illustrated, and complete in its scope This chapter can be recommended as an absolutely safe guide to young surgeons in this field, and will be read with interest and, one may almost hazard, enthusiasm, by those of longer experience

Mr Carson himself deals in many separate chapters with most of the abdominal surgery, and maintains a uniformly high standard throughout He has been fortunate in being able to incorporate in his chapter on the stomach a verbatim description by Sir Berkeley Moynihan of his operation of partial gastrectomy and in the chapter on treatment of carcinoma of the rectum, a description of the abdomino-perineal removal is contributed by Mr Miles One almost feels that these two contributions would justify the inclusion of Mr Miles' and Sir Berkeley's names in the list of authors

Surgery of the genito-urinary tracts is dealt with by Sir John Thompson Walker and Mr Everidge, the former's writings on this subject are so well known and so widely accepted that it is hardly necessary to state that this section of the book is one of the most satisfactory

Mr Giles deals with gynaecological operations, and has compressed into 70 odd pages an amazingly complete survey of the whole field

Mr Harmer writes on operations on the nose and pharynx and Mr Brewerton on operations on the eye These chapters like those on the ear by Mr Richard Scott, and on the larynx by Mr Bedford Russell, are necessarily somewhat compressed, but they are all well illustrated and well adapted to widen the usefulness of the book for those surgeons who from time to time have to practise in these special fields

There can be no question that Mr Carson has succeeded in producing a most useful book, which will be read doubtless mostly by young surgeons in place of the more voluminous works on operative technic, and they will find in it not alone a safe guide as to the operations which now hold the field, but the kind of description which will best help them to tackle their work for the first time with confidence The volumes will also have a value as a reference book for older men, and one anticipates rapidly recurring editions if it is to remain, as it stands at present, a record of the best surgical procedures of the moment

E P G

### To Contributors and Subscribers

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn N Y

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

**ANNALS of SURGERY**

**227-231 So 6th Street**

**Philadelphia, Penna**

# ANNALS *of* SURGERY

VOL LXXXII

SEPTEMBER, 1925

No 3

## THE SURGICAL TREATMENT OF HABITUAL CRIMINALS, IMBECILES, PERVERTS, PAUPERS, MORONS, EPILEPTICS AND DEGENERATES \*

BY ALBERT J OCHSNER, M D

OF CHICAGO, ILL

MORE than twenty-three centuries ago Plato (424-344 B C ) advocated castration as a punishment for certain crimes Since that time the subject has been advocated many times, especially by authors interested in eugenics, insanity and criminology, but not by surgeons In many communities mob justice has made use of this idea in the treatment of isolated cases During late years fifteen states have passed laws for the sterilization of individuals belonging to those classes

There has been strenuous objection raised to this form of punishment, especially by the clergy, because it seemed to them to be a direct interference with the will of an allwise Providence There was also something repulsive in the idea, because it seemed to contain a feeling of hatred toward the criminal It also seemed to mark the criminal as an outcast In earlier years it involved considerable risk to the criminal's life, thus resulting in the possibility of unintentional capital punishment Moreover the operation involved physical suffering and a repulsive deformity and an interference with the criminal's constitutional right of enjoyment of "Life, liberty and the pursuit of happiness," after having undergone the hardships resulting from the just punishment of his crime It has also been objected to because it was considered a cruel and unusual form of punishment which is considered unconstitutional

In former times a condition which has loomed up to a remarkable extent of late could not be brought to bear upon this question as it can at present The portion of the human family belonging to the group under consideration was so poorly cared for by society that most of the members' lives were not unduly prolonged There was a natural elimination of the individuals belonging to these groups Until comparatively recent times the biblical quotation remained true which said, "The children of the wicked shall be cut off" The death-rate during early life of their offspring was so great that only a relatively small portion remained as a burden to society because but few of them attained adult life This, however, has all been changed by our modern methods of caring for these groups Society at the present time

\* The Presidential Address delivered before the American Surgical Association, May 4, 1925

provides such excellent protection and care for all of the members of the groups under consideration that the scriptural quotation, "The wages of sin is death," has lost its force to a very great extent, and it is for this reason that society will be forced to protect itself against their progeny

Criminals and defectives are exceedingly prolific, as has been demonstrated many times statistically, which is shown by the study of the histories of families belonging to these groups. One of the most striking examples is that of a well-known worthless family which settled in the State of Indiana some generations ago, consisting of a feeble-minded husband and wife, who were shiftless and given to thieving. Their descendants now number nearly 1200, most of them, at best, a burden to society and many of them degenerates, or criminals.

Another equally striking case, which has been carefully studied and described by Dr. Henry H. Goddard, Director of the Juvenile Research Bureau of the State of Ohio and formerly Superintendent of the School for Feeble-minded at Vineland, New Jersey, is the one known as the Kallikak family, whose history has been published so often that it need not be repeated here except as to its results. The descendants from the same father and a feeble-minded girl number 480, among them 143 known feeble-minded, 36 illegitimates, 33 sexual immoral, 24 confirmed alcoholics, 3 epileptics, 3 criminals, 8 keepers of brothels and 83 children so feeble that they died in infancy. On the other hand, the descendants of the same father and a fine mother comprise 496 normal people, all having lived normal, honorable lives without being a burden upon the public and many having given important public service. The provisions which organized society has established for their preservation has resulted in an enormous increase in the number of members of the groups under consideration.

Government statistics for the year 1915 show that the direct expense to our government for the care of these classes in charities, hospitals and corrections amounted to the enormous sum of \$89,189,000, which is more than all the money spent in the maintenance of all the universities of this country. For the year 1922 this sum had increased to \$162,469,000, an increase of 80 per cent in a period of seven years. Almost the same proportions exist for the State of Illinois. For the year 1915 the cost amounted to \$5,458,504, and this had increased to \$8,901,247 for the year 1922. These classes do an enormous amount of harm and destroy a great amount of property each year which cannot be calculated, but which represents an enormous loss to the honorable portion of society at large, aside from the cost to the public for their support.

The amounts represented above simply represent the actual money expended by society for protection against these classes and for their care in institutions. This has produced a tremendous, rapidly increasing burden upon the remaining portion of society, because the care and support of the appalling number of these individuals and their offspring in penal institutions, asylums, almshouses, homes for defectives and hospitals produces an enor-

mous expense which is increasing from year to year, and which brings no benefit to those bearing the expense except a certain amount of protection

It has been shown by statistics collected in the State of Indiana that one hundred families have committed more than one-half of the crimes done to native-born citizens during the past generation. But this is not all, for the offspring of the respectable members of society are constantly exposed to the harmful influence of contact with these degenerate classes and their offspring. Moreover, the lives of the offspring of these unfortunate classes are full of trouble and sorrow from their beginning to their miserable end, and few if any members of these classes do not regret the fact that they were born. In the same way the children of these classes are practically never welcome to their parents. Hence, depriving the latter of the possibility of progeny would in no way result in a hardship to these individuals.

If then it is possible, by the surgical treatment of these cases, to reduce the number of their progeny, it seems reasonable to advocate this surgical method so that society can be protected against at least a part of the harm it now suffers without harming the individuals who receive this surgical treatment. It seems to be plainly our duty not only to advocate methods which will save life and relieve suffering of the individual patient that comes under our care, but quite as much to protect society against unnecessary hardship.

The form of treatment I wish to advocate consists in the ligation and section of the vasa deferencia.

This can be accomplished in less than two minutes by any surgeon. The steps of the operation are as follows: (1) disinfection of the skin area, (2) infiltration of the skin and the tissues about the vas deferens with 1 per cent of novocain solution, or one of its equivalents, (3) an incision 2 cm long, (4) the bringing forward of the vas, (5) double ligation 1 cm apart with silk or catgut, (6) section of the vas above the point of ligation, (7) closure of the wound with one or two catgut sutures and dressing of the wound.

This operation causes absolutely no pain and no deformity, does not endanger the life of the patient and does not in any way interfere with his sexual life with the one exception that it prevents reproduction. We have demonstrated many times in cases of double vasectomy for tuberculosis of the vas that the sexual life of the patient is not changed in the slightest degree. Some of these cases have enjoyed normal sexual life for a period of more than twenty-five years since the operation. In case the operation should at some time be performed erroneously, the vas can be restored.

This form of treatment will then effectually protect the community against the progeny of the individuals treated, without carrying with it the slightest harm to that individual. It does not contain the element of punishment and can therefore be applied to the other non-criminal classes contained in the group under consideration in the same manner that it can be applied to the



habitual criminal Not containing the element of punishment, existing laws for the punishment of criminals would not have to be modified in any way because of the introduction of this form of treatment of the criminal

At this point a word might be said concerning the sterilization of females of these classes Nature has provided for the sterilization of almost all female criminals because they are practically all sterile as a result of gonorrhoeal or luetic infection

The female belonging to the other classes in this group should all be sterilized by the use of deep X-ray therapy, or by the ligation of the Fallopian tubes

The objection which has been offered, especially by the clergy, is on a par with that offered in times past against vaccination for the protection against small-pox and other measures which seemed to prevent the functioning of the wrath of God through visitation of disease upon the inhabitants of a sinful world With the increase of intelligence this obstruction must disappear, because it belongs to a type quite proper some centuries in the past, but no longer proper in this enlightened age It must dawn upon these objectors that if Providence had planned non-interference the anatomic possibility of this interference would have been less obvious There can be no doubt but what society has the absolute moral right to protect itself against harm from this source the same as from the many other forms of injury provided for by existing laws

Everyone who has handled domestic animals knows that vicious characteristics of these animals are transmitted from parent to offspring, and this knowledge is made use of constantly in the selection of sires in the breeding of domestic animals That the same is true in the human family has been proven constantly as shown by the accompanying well authenticated examples and by an endless number of similar observations

Aside from this in case of criminals the influence of environment has, of course, a distinctly harmful effect, because the offspring of criminals are always born into a criminal environment

A noted criminal lawyer who has been active constantly in the criminal court of a great city for many years states that he has many times encountered the sons of criminals guilty of the identical crimes for which their fathers were prosecuted many years before

Fifteen states in the Union have passed laws authorizing sterilization for certain conditions Of these nine are still in force, five having been declared unconstitutional and one having been repealed

In 1922, the law had been carried out in 3233 cases, of which 2558 had been operated in the State of California

All of these operations were performed upon insane patients in State Hospitals for the Insane

Dr F W Hatch, General Superintendent of Hospitals for the Insane of California, states that in his enormous experience vasectomy in the insane is followed in many cases by marked improvement in the mental condition,

## PRESIDENTIAL ADDRESS

which may be due to the absorption of secretion from the severed vas deferens, although suggestion may also have had a favorable influence. Dr H C Sharp, Physician to the Indiana Reformatory, who has applied vasectomy since 1899, states that he has had under his post-operative observation 236 of these cases. He has never seen any unfavorable symptoms in any case. There has been no atrophy, no cystic degeneration, no disturbed mental or nervous condition, while he has noted improvement in the condition of some patients.

There is no doubt but what efficient laws can be passed, whose constitutionality will be upheld by the courts.

### CONCLUSION

- 1 This form of treatment will eliminate in coming generations many individuals who would otherwise be born with vicious hereditary tendencies.

- 2 It will relieve society of much harm from contact with members of these classes.

- 3 It will greatly reduce an enormous useless financial burden.

- 4 It will remove from normal society the harmful influence due to vicious environment.

- 5 It will not injure the individuals treated.

- 6 It will cause no pain, produce no deformity, incur no danger to life, and it will not interfere with the health and happiness of those treated.

- 7 It will prevent the wretched existence of a most unfortunate class, who otherwise would have to suffer because of hereditary defects.

- 8 It is important to bear in mind that the proposed treatment is not a form of punishment, but a reasonable protection to future generations.

# THE CONCEPTION OF SEPTICÆMIA AND THE FATE OF MICROBES IN THE BLOOD STREAM\*

By WALTON MARTIN, M D

OF NEW YORK, N Y

IF LIVING pathogenic microorganisms penetrate the blood stream, is the blood infected as the cellular tissue is infected in a spreading phlegmon? Since the matrix is fluid in which the blood cells and the bacteria are floating, is an opportunity offered for the introduction of a chemical which will destroy the microbes and prove harmless to the living cells? It has seemed to me timely to attempt to bring forward some of the evidence available which may help to answer these questions. Timely, because a number of truly astounding recoveries have been reported, based on the assumption of an affirmative answer to both questions.

It has been shown by repeated experiments that if an inert substance, like lampblack, is introduced into the blood, it disappears in a short time. It is not passed out of the body by the urine or by any of the various excretions or secretions. The minute particles of the injected substance settle out from the blood where the circulation is unusually slow in the peculiar capillary meshwork of the spleen, the liver and the bone marrow. There they come in contact with a special group of cells and are taken up by them. These cells belong to a group now spoken of as the reticulo-endothelial system and are distinguished not only by a pronounced capacity for phagocytosis but by their special reaction to certain vital stains. It is well recognized that phagocytosis is a property of many other body cells, but it is a peculiar and especial function of these cells.

In experiments recorded in a paper by Hobo,<sup>1</sup> the material used was fine India ink and the amount used from 25 to 30 c c. The particles were the same size or smaller than staphylococci and the solution was injected into the ear veins of rabbits. The visible mucous membranes immediately became dark gray, at the end of ten minutes this color had disappeared. The animals were killed at periods varying from forty-five minutes to seventeen days after the injection. At autopsy the spleen, the bone marrow and the liver were found to be stained black. The other organs and tissues—the lungs, heart, brains, nervous tissue, gastro-intestinal tract and the kidneys were unstained. The microscopical examination showed, even in the early stages, particles of India ink in the star cells of Von Kupffer of the liver, the sinus endothelial cells and the pulp cells of the spleen and the endothelium of the capillaries of the bone marrow. In the capillary enlargement of the metaphyses of the long bones the particles were so thickly deposited that it was impossible to recognize the phagocytosis. In the lungs and kidneys, clumps of the pigment

---

\*Read before the American Surgical Association, May 5, 1925

## THE CONCEPTION OF SEPTICÆMIA

were seen here and there. Scattered through the various organs were mononuclear and polymorphonuclear leucocytes filled with the black particles.

During the last forty years numerous experimenters have shown that microbes injected into the blood current are deposited and detained in exactly the same way in the liver, the spleen and the bone marrow. The completeness and rapidity with which they are removed and their predilection for certain organs and tissues vary with the different microbes.

The precise and interesting experiments made by Wyssokowitsch<sup>2</sup> over thirty-nine years ago brought out many of these points. He used fresh cultures of moulds, saprophytic, pathogenic and non-pathogenic bacteria and experimented on dogs, rabbits and guinea pigs. Relatively large quantities were injected into a vein, blood was then withdrawn at intervals of from ten minutes to twenty-four hours, cultures were taken and the colonies counted. Enormous quantities of spores of moulds (*aspergillus* and *penicillium*) and saprophytic bacteria disappeared with astounding rapidity. Within three hours, millions of bacilli (*bacillus subtilis*), injected intravenously, had completely disappeared. Bacteria, pathogenic for man but harmless for the animals experimented on, disappeared in the same way. Thirty minutes after the injection of millions of cocci (*streptococcus pyogenes*) into the circulation of a dog, only one colony was found on the blood culture, in one and a half hours the blood withdrawn was sterile. Even after injections, repeated each day for four days, of many millions of microorganisms (*micrococcus tetragenus*) into the blood of rabbits, only six colonies had grown from the blood culture at the end of twenty-four hours.

The disappearance of bacteria pathogenic for the animal, injected in small quantities, was equally rapid. In some instances it was complete, that is, the blood withdrawn from a rabbit, into the blood stream of which anthrax bacilli had been introduced, showed no organisms at the end of twenty-four hours. If larger doses were introduced there was first a diminution, then an increase, until the bacteria became countless. In a rabbit injected with a large dose of anthrax bacilli, at the end of five minutes only fifteen colonies were found in the withdrawn blood. At the end of two and a half hours there were no colonies, at the end of forty-six and a half hours, three colonies, at the end of seventy hours, fifty-six colonies, at the end of eighty-four hours, death followed with countless numbers of bacteria in the blood stream. The animal in which no organisms were found in the blood at the end of twenty-four hours was killed. Cultures from the blood showed no growth, however, forty-five colonies grew from a culture taken from the spleen and countless colonies from the liver. In animals that died after the injection of large doses of pathogenic organisms, autopsies regularly showed not only the liver, spleen and bone marrow, but all the tissues and organs swarming with bacteria. The blood itself, in the larger vessels, contained but a small part of the myriads of microbes found throughout the body.

It is well to bear in mind that conclusions drawn from such animal experi-

ments should only be applied with caution to human beings. In the first place, the infecting agent is almost never introduced in large quantities intravenously into a healthy person. There is almost always a local area from which at first relatively few bacteria enter the circulation and such slow introduction sets up most important changes in the behavior and response of the body cells to the exciting agent. Even when a local tuberculous focus, for example, ruptures into a vein and tubercle bacilli in millions are carried through the body by the venous current, important changes must already have been set up in the body reactions by the presence of the bacteria in the original centre of activity. The great differences in the natural resistance of the various animals to the various exciting agents and in the virulence of the microorganisms, are too well known to be more than mentioned. There are also curious minute anatomical differences which cause confusion, such as the distribution of the reticulo-endothelial cell groups in different animals.

One may summarize the results in a very general way as follows. Microorganisms settle out from the blood where the current is unusually slow, they are very minute and behave at first as minute lifeless particles behave. It is clear that such settling out insures an opportunity for chance contact and adhesion with special cells. This contact is accompanied by phagocytosis and the formation of various bactericidal substances. If pathogenic bacteria are lodged and chance to grow various toxic substances are produced which in their turn are harmful to the body cells.

That bacteria enter the blood from time to time and give little or no evidence of their presence is well recognized. There is a curious experiment which I think worth recording. It was in 1879 in the early days of the study of the pathogenesis of infections. Watson Cheyne<sup>7</sup> made cultures from various abscesses on cucumber infusion. He thought at the time that the bacilli were pathogenic and that the cocci were not. He injected into his own arm, on two occasions one and five minims of a culture of micrococci. He estimated that each minim contained at least two million microbes. There was no appreciable local or general reaction.

The usual sequence of events when infection occurs is as follows. At first there is a centre of activity with multiplication of bacteria and the formation of toxins, from this local focus the toxins and bacteria enter the blood, these bacteria are very rapidly taken up and destroyed by the cells of the reticulo-endothelial system at the same time this system elaborates bactericidal substances. Microorganisms are only very occasionally to be detected in this stage in the blood and usually only when a considerable number enter the blood stream at once. Gradually, however, the toxins of the bacteria inhibit or destroy the phagocytic cells and the bactericidal substances in the blood become less marked. The bacteria remain longer alive in the blood and, during this stage, certain of them may gain foothold and begin to grow in various parts of the body, forming secondary centres of activity and from these more bacteria and toxins enter the circulation. Finally, the phagocytes no longer

act, bactericidal substances are no longer formed, the microorganisms multiply throughout the body, myriads are poured into the blood from the spleen, bone marrow and liver and from the various secondary foci. In the early stages, even after repeated predatory incursions of bacteria, the microbial raids may cease and recovery take place, and recovery may also follow if the bacteria are cut off from entering the circulation or if the focus be completely removed. Every phase of this contest between the organisms and the body cells is seen. Now one, now the other, seems to be victorious. All manner of transitional forms exist. There are periods in which the bacteria are being killed or taken prisoner as soon as they appear. There are periods in which they are completely victorious. In looking at the contest at any given moment, it may be impossible to determine the outcome. It may be impossible, when living organisms are found in the blood stream, to be sure whether they are multiplying there or whether they are pouring into the stream from various foci. It is for this reason that the term septicæmia is no longer defined in the textbooks as a condition in which the organisms are actually multiplying in the blood current. The conception of septicæmia today implies the presence of living pathogenic microorganisms in the circulating blood. In common usage, one speaks of typhoid septicæmia and pneumococcus septicæmia when bacteria are present in the blood in typhoid and in pneumonia. Bacteræmia and septicæmia have come to be synonymous terms. In the chapter on septicæmia in the last edition of *Choyce's Surgery* (1923), bacteræmia is written in parenthesis after septicæmia. The term is used whenever there is actual, direct evidence of microorganisms in the circulating blood. Malaria stands out as a disease in which the older conception is most apt. Here organisms are actually proliferating in the circulating blood. The contest between the merozoites, which are set free after the disintegration of the red cells, and the leucocytes, may be actually in the peripheral blood stream. But in the astivo-autumnal type of the disease the development of the larger ameboid forms takes place largely in the spleen and the bone marrow and as soon as the plasmodium has grown a certain size it is no longer found in the circulating blood. It is discovered, however, in blood obtained by puncture from the spleen. And in the fatal cases, at autopsy, enormous numbers of the parasites, in all stages of development, are found in the spleen, the liver and the bone marrow.

In septic conditions following grossly contaminated wounds, such as are seen after gunshot injuries, special studies have shown bacteria in the blood stream, not only in severe types, but in many of the milder forms <sup>4, 5</sup>

The course of events in the septicæmia following infection of the uterus has been very carefully studied by a number of observers. The raw surface left on the uterine wall after the separation of the placenta, the imperfectly drained cavity, the presence of decomposing fragments of placental tissue and blood clot, the rich supply of lymphatics and blood-vessels, all offer an unusually favorable opportunity for the growth of both saprophytic and pathogenic bacteria and their dissemination. It has been customary to group these cases

under the terms *sapræmia* and *septicæmia* but painstaking blood studies have shown that the cases grouped under *sapræmia* are frequently accompanied by *bacteraemia* and that, here again, all transitional forms between mild and severe types of *septicæmia* (*bacteraemia*) exist. The case reports and studies of Lenhartz <sup>6</sup> in this connection are most interesting.

The sequence of events in many *septicæmias* is somewhat different. The initial focus of infection is inconspicuous or absent. Bacteria pass from the initial lesion or from the portal of entry through the blood stream without any perceptible reaction on the part of the body. There is no direct evidence by blood culture of their presence. But just as we are accustomed to assume the passage of streptococci through the lymphatics when we find a small infected area on the little finger preceding an obvious phlegmon in the region of the epitrochlear gland, so in these cases the sequence of events seems to make it difficult to think of other explanations. For example, a small furuncle, a pustule or a trifling infected wound regularly precedes the development of an *osteomyelitis*. Staphylococci must pass from these small lesions directly or indirectly into a vein and be carried to the right heart, then through the lung capillaries and finally settle out where the circulation is unusually slow, in the liver, spleen and bone marrow where they are destroyed. In the young animal, however, in the large venous capillaries of the metaphyses of the long bones, masses of the lodged bacteria are not killed but start to grow and the lesions of *osteomyelitis* are produced. Hobo (*1c*) has observed a lessened power of phagocytosis or an absence of it at just this point whereas there is an active phagocytosis in the endothelial lining of the capillaries of the shaft.

It is well recognized that masses of bacteria can be established in a focus and maintain themselves in areas where the natural resistance is weakened. From these secondary centres of bacterial activity toxins and bacteria pass into the circulation. When they pass in considerable numbers they may be recognized by blood culture and the sequence of events that we described above takes place. The only difference is that the active foci, the ones with which we are familiar, the ones that we associate with the disease, are actually secondary foci.

The phase when the bacteria are passing unnoticed from a primary focus to become lodged in a secondary focus corresponds to the period of incubation in many of the so-called infectious diseases. During this period, the body shows no reaction to the invading bacteria. There is no chill or temperature or sign of illness. These start with the invasion of the blood stream from the established secondary focus or foci.

The comparison, first made by Virchow, of the struggle between the body cells and their products with the microbes and their toxins, as a battle, may be extended. This phase of the contest is like trench warfare. The first bacterial raids are carried out as surprise attacks. Very quietly, before it is realized, without the exchange of a shot, a trench is taken. From this trench,

after a time, further raids are made, but now under a destructive fire. Time after time, the raiding bacteria are destroyed by the phagocytes and bactericidal substances manufactured by the aroused body cells. Animal experiments have shown that by varying the dosage of microorganisms, that is, the numbers introduced, almost all the lesions that we are accustomed to see in the pyogenic infections may be reproduced. But in man these variations seem to be brought about rather by the varying phases of resistance and sensitiveness offered by the fluids and cells of the body to the invading organisms during the period when the microbes pass from the initial lesion to various parts of the body. That these phases have a most important bearing on the interpretation of the results of treatment and on the questions connected with subsequent infection, reinfection and superinfection, is evident.

Bacterial contamination of the blood stream is well shown in the study of infections of the middle ear. The mastoid cells are in close proximity to the lateral sinus. It has long been recognized that an infective thrombophlebitis not infrequently follows infection here, either by direct involvement of the walls of the sinus or by extension to the sinus through one of the minute communicating veins and that such involvement is made evident clinically by chills and fever. Cultures taken during these periods very frequently show the presence of bacteria in the blood stream. The prompt ligation or removal of the infected vein stops the process and the patient recovers. Although large numbers of bacteria have been poured into the blood they disappear completely, and the patient recovers if the bacterial showers stop spontaneously or are cut off. The blood is bactericidal, the body cells destroy the microorganisms.

In malignant endocarditis, again, the focus of infection is directly in the vascular system. Careful studies have shown that for long periods the blood possesses powerful bactericidal properties against the very organisms producing the lesion. That pathogenic microorganisms can maintain themselves in a nidus while the circulating blood has powerful destructive properties for the particular microbes in the nidus, has been proved in a great variety of infections.

Our conception of septicæmia, built up by clinical observations made when pathogenic bacteria are detected in the circulating blood, must take into account all these cases. Examination of the contaminated blood gives but a small indication of the complex phenomena taking place. The number of microbes discovered may be but a portion of the myriads in the body or may only indicate the passage of hundreds of thousands on their way to destruction. To speak of the blood as infected in the sense that a local area is infected is misleading. The failure to consider the phenomena connected with the appearance and disappearance of microorganisms leads to most erroneous conclusions.

Since Ehrlich introduced the intravenous injection of salvarsan with such success in the treatment of syphilis, a number of other chemical substances



have been suggested and used intravenously for microbic infections. Not only Ehrlich's brilliant discovery but the scientific conception that prompted his work, the painstaking studies of the various chemical compounds, the addition of atomic group to atomic group with a definite purpose, until the complex chemical compound salvarsan (dioxydiamedarsenobenzol dihydrochloride) was discovered with the properties required—the extension of the well-known side-chain theory to chemotherapy, all stimulated work and encouraged the hope that similar chemical substances with specific activity might be found for other microorganisms. It is interesting to note that in offering an explanation for the action of salvarsan, the active formation of antibodies called forth by the parasites killed just after the injection was considered and a warning given of the danger present in certain cases from the endo-toxins liberated from the enormous number of spirochaeta killed. His warning also against the use of the toxic chemical in patients with serious organic lesions and his unwillingness to have the drug placed on the market until it had been tested on twenty or thirty thousand patients are all worthy of attention and imitation.<sup>7</sup>

The well-known therapeutic action of quinine on the plasmodia of malaria led Morgenroth and others to work on chemical substitution products in the molecules of this substance and finally to the discovery of optochin, which has fifty times the power of quinine and kills *in vitro* pneumococci in a dilution of one to a million. Another compound—acridine, with its derivatives, flavine and acriflavine (tripaflavin proflavin of the Germans) has also been studied extensively. A preparation containing 0.5 per cent of free hypochlorous acid made by dissolving a definite amount of chlorinate of lime and boric acid in equal parts in water, was introduced under the name of eusol and has been used not only as a local antiseptic but intravenously in various septic conditions. Churchman<sup>8</sup> who began his studies on bacterial stains in 1910 has recently shown the selective bacteriostatic action of gentian violet and other dyes and, still more recently, Young<sup>9</sup> and those working with him have called attention to the bactericidal properties of mercurochrome and have used all these dyes intravenously in a variety of septic conditions. A large number of papers have appeared, from 1910 to 1923 there were 306 articles dealing only with the quinine and acridine derivatives.<sup>10</sup> It is obviously impossible to review all the material presented in the time available. I shall only refer to a few very recent articles.

A paper read last autumn by Carrick Robertson<sup>11</sup> presented a number of case reports of patients treated by intravenous injections of eusol. In his first case there had been sepsis following furunculosis. No mention is made of the site or extent of the lesion. In another, a most unfortunate accident had apparently occurred, an intra-peritoneal abscess spreading from the pelvis to the lumbar gutters had followed a simple ventral suspension. There was also an abscess in the abdominal wall. These foci were opened and drained but the patient continued very ill. Intravenous injection of eusol was fol-

lowed by a chill, a temperature of 106 and by prompt recovery. In another instance, pneumonia was followed by empyema. The thoracic cavity was opened and drained. A lung abscess evidently followed, for the patient is described as lying face down over the side of the bed while foul smelling pus poured from his mouth. He was given an intravenous injection and recovered. I have referred to these reports without other comment than that they seem to me to show the unsatisfactory nature of the clinical evidence offered.

In a report of Young and Hill (16) on seven patients treated intravenously by mercurochrome and five by gentian violet, the results are described as almost miraculous, the patients being "snatched from the jaws of death." In a staphylococcus septicæmia in an infant there were multiple abscesses. The child is described as almost moribund; there were three positive blood cultures. The desperate condition of all the patients described is the most striking feature. Recoveries are reported in several cases of far-advanced terminal septicæmia. The blood is described, in each instance, as sterilized by the chemical. Brill and Myers,<sup>12</sup> however, report that in five cases the intravascular injection of mercurochrome and gentian violet in no way interfered with the progress of the general septic infections. The organisms reported in their cases were streptococcus, staphylococcus and colon bacillus. Meleney and Zau,<sup>13</sup> in January of this year, drew the conclusion from carefully carried out tests that the bacterial inhibiting action of neutral acriflavine within the body of the rabbit is so slight against the hæmolytic streptococcus, even in lethal doses of the dye, that it is not a legitimate intravenous medication and that it has a distinctly harmful effect, especially on the cells of the liver and kidney.

On the medical service at St. Luke's Hospital, gentian violet, mercurochrome and acriflavine have all been administered intravenously in patients suffering from endocarditis with positive blood cultures of streptococcus viridans. None of the patients showed an improvement that could be fairly attributed to the medication. All four of the patients eventually died. The characteristic reaction after the injection was regularly seen.

There can be no question of this powerful reaction following the intravenous injection of certain chemicals, the chill, temperature, diarrhoea, appearance of the patient, all suggest a violent disturbance. One cannot dismiss the evidence presented of rapid recovery. But how often does it occur, how much is due to the bactericidal action of the drug, how much is due to its toxic effect on the body cells? It should be borne in mind that shortly after its introduction into the blood the chemical comes in contact with the cells of the reticulo-endothelial system, which we have referred to as concerned in the defense mechanism of the body, and almost certainly profoundly influences them. May it not be that at times substances are liberated that are harmful to the bacteria? Is not the action dependent on how much the drug stimulates or conserves the natural defense mechanism of the body?

At other times, may not some of the chemicals introduced produce various degenerative changes in the cells of the liver, the spleen and the kidney?

Dramatic reports of collections of heterogeneous clinical material is not convincing. Shall we speak, in coming years, of the sterilization of the blood or the poisoning of the body cells by the intravenous injection of certain of these chemicals? We have seen that contamination of the blood stream occurs under a variety of conditions. In many cases blood cultures show simply showers of bacteria, the absence of bacteria in the blood stream often indicates but examination between showers. Many so-called septicæmias terminate with startling suddenness untreated.

It should be possible to present the reports of experiments on a large series of animals with the characteristic lesions of generalized infections from microbes, with controls that show the arrest of the infection and recovery after the intravenous injection of the various chemicals used. This has been done in many instances in the study of the quinine and acridine derivatives. Patients with ulcerating lesions on the heart valves and bacteremia seem to me to offer the most suitable clinical material for study. The streptococcus, the staphylococcus and, rarely, the gonococcus, have all been observed as exciting agents. The lesion is local, accessible to the antiseptic, in the early stages the blood already possesses properties harmful to the bacteria and, although in the mild cases there are periods of remission, this disease is progressive.

The only microorganisms so far successfully combated in the human being by chemicals are the exciting agents of malaria and syphilis. Although there is much disagreement about the proper classification of the true spirochæte, it may be said that neither belongs to a group of true bacteria. The plasmodium of malaria is one of the pathogenic protozoa and the zoologist, Schaudinn, the discoverer of the *treponema pallidum*, placed this organism also in a group with the protozoa. In neither instance do we speak of sterilizing the blood. We speak of curing or arresting the disease.

The point I wish to emphasize is that in the generalization of infection a very complex process is passing on in the body. The presence of microbes in the blood is but one phase or part of this process. To speak of the blood as infected in the sense that the cellular tissue is infected in a spreading phlegmon is erroneous and misleading. To speak of the blood being sterilized by the intravenous injection of a chemical as a test tube containing a broth culture is disinfected, is equally misleading and erroneous.

#### BIBLIOGRAPHY

- <sup>1</sup> Hobo, T. Pathogenesis of Osteomyelitis. Acta Scholæ Med, Univ Imp, Kyoto, 1921, vol iv, p 1 (Bibliography)
- <sup>2</sup> Wyssokowitsch, W. Ueber die schicksale der in's blut injicirten mikroorganismen im korper der warmbluter. Zietsch fur Hygiene, 1886, vol 1, p 3
- <sup>3</sup> Cheyne, Watson. Trans of the Path Socy of London, 1879, vol xxx, p 560
- <sup>4</sup> Anderson, H M, and Richardson, G. Septicæmia in Gunshot Wounds. Brit Jour of Surg, 1918, vol v, p 393

## THE CONCEPTION OF SEPTICÆMIA

- <sup>5</sup> Legrain, Pierre Septicæmies au cours de l'évolution des blessures de guerre Theses, Paris, 1917-18
- <sup>6</sup> Lenhartz, H Die Septischen Erkrankungen, 1903, p 462
- <sup>7</sup> Ballinger, E G 606, or Dioxydiamedoarsenobenzol N Y Med Jour, 1910, vol xcii, p 1157
- <sup>8</sup> Churchman, J W The Selective Bacteriostatic Action of Gentian Violet and Other Dyes Jour of Urology, 1924, vol xi, p 1
- <sup>9</sup> Young, H H, and Hill, J H The Treatment of Septicæmia and Local Infections by Mercurochrome 220 Soluble and by Gentian Violet Jour A M A, 1924, vol lxxxii, p 669
- <sup>10</sup> Laqueur, E Die neuen chemotherapeutischen präparate aus der chininreihe und aus der akridinreihe, 1923 (Bibliography)
- <sup>11</sup> Robertson, Carrick Intravenous Injections in Septic Conditions Surg, Gyn and Obst, 1925, vol xl, p 218
- <sup>12</sup> Brill, L C, and Myers, H B Mercurochrome 220 Soluble and Gentian Violet Jour A M A, 1925, vol lxxxiv, p 879
- <sup>13</sup> Meleney, F L, and Zung-Dau Zau Action of Acriflavine on the Blood and Certain Tissues of Rabbits Jour A M A, 1925, vol lxxxiv, p 337

# FAT EMBOLISM\*

WITH STUDY OF TWO FATAL CASES

By ARTHUR W. ELTING, M.D.

AND

CHARLES E. MARTIN, M.D.

OF ALBANY, N. Y.

IT HAS long been known that free liquid fat may under certain conditions gain access to the blood-vessels and be transported in the blood stream. Fat in this form, of course, is to be more or less sharply distinguished from fat in the minute particles of emulsification or saponification, which plays little,

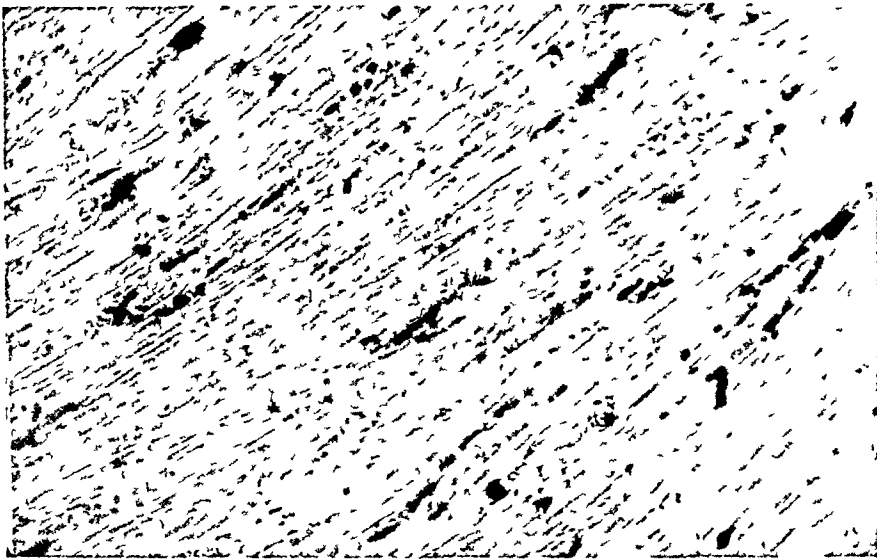


FIG. 1.—Case I. Heart. Scharlach R. and hematoxylin showing numerous fat emboli, congestion and interstitial edema.

if any, important role in the production of embolism. Fat embolism is essentially a surgical complication and usually occurs as a sequel to trauma especially of

the long bones or fatty structures of the body. In any instance in which fat is set free from ruptured fat cells, more or less embolism may result, the symptoms of which will depend not only upon the amount of fat which enters the blood stream, but also upon the localization of the fat emboli in the capillaries.

Fat gains access to the circulation mainly through ruptured blood-vessels, but it is also probable that a small amount of fat may reach the circulation through the lymphatics by way of the thoracic duct. In the great majority of instances it is probable that the amount of fat entering the circulation is small and the localization not serious, so that few or no symptoms may ensue and no suspicion of the condition be had. In a smaller number of cases, but probably far more frequently than is generally recognized, fat emboli do produce symptoms which are usually attributed to other

\* Read before the American Surgical Association, May 5, 1925.

causes, and in a still smaller number these symptoms are of great severity, and death ensues. Comparatively few correct clinical diagnoses of fat embolism have been made, and the pathologists, too, have undoubtedly overlooked the condition in many instances.

The object of this paper is to call to the attention of the surgical profession a condition of great importance, and in our judgment of relatively frequent occurrence, and to present the clinical picture and the pathological findings in two cases which have been carefully studied. Historically, much has been written about fat embolism, chiefly by the German pathologists beginning with

Vuichow in his classical work on embolism in 1862. Zenker, in 1862, observed the first case of fat embolism of the pulmonary capillaries in man, and during the succeeding years many articles were written and

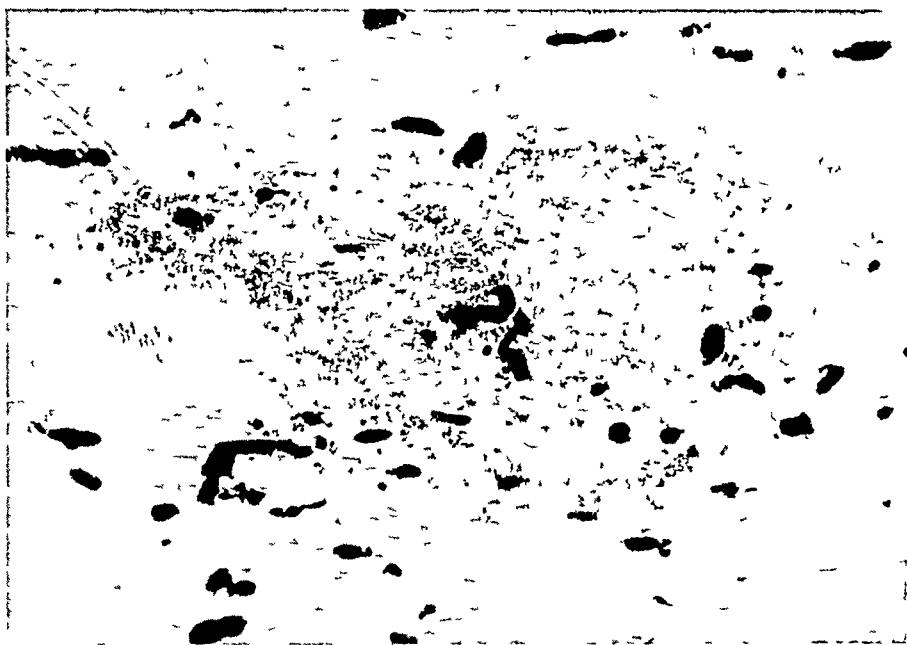


FIG 2—Case I Heart Osmic acid preparation Colony of fat emboli with muscle fibres undergoing fatty degeneration

much experimental work done, chiefly on the continent. During the past few years certain American writers have given especial attention to this subject. The most complete survey of the literature, together with the most exhaustive study of the condition made up to that time was the article published by Warthin in 1913 in the *International Clinics*. To Warthin's summarized observations and conclusions practically nothing of importance has since been added. It is a striking fact that this condition seems to have been almost entirely overlooked by American surgeons, and the references to this condition in American surgical literature are singularly lacking and inaccurate.

CASE I—J. M. H., aged twenty, a strong, healthy, athletic young man, whose past history was negative, was riding on the front seat of an automobile beside the driver at about 3 A. M., October 12, 1924, when the car crashed into a telephone pole, and the patient sustained closed fractures of both femora in the middle thirds. He was transported with all possible care to the Albany Hospital, where he was admitted to the surgical service about two hours after the accident. Retentive dressings were applied with the minimum of manipulation and the patient given a small dose of morphine. The patient was carefully examined by Doctor Elting at 10 A. M., at which time the temperature was normal, the respirations 20, and the pulse 100. There was considerable swelling and ecchymosis of both thighs, but no manipulation was indulged in. There was



## FAT EMBOLISM

drips In either lung are several irregular hemorrhagic areas, 1 to 2 cm in diameter and having a lobular distribution

The pericardial cavity contains 50 ccm of a clear yellow fluid Scattered over the epicardial and endocardial surfaces but most abundant in the right ventricle are numerous petechiæ 1 to 2 mm in diameter They also occur in the myocardium, where they are often surrounded by a narrow, yellow opaque zone

In the pelvis is an extensive subperitoneal hæmatoma It covers the superior surface of the bladder and continues up over the brim of the pelvis well into the tissues of the posterior abdominal wall The hæmatoma is most marked over the superior ramus of the right pubis, which is fractured The bone is fragmented, dislocated, and the edges much roughened

Pin-point hemorrhages scattered throughout the mucosa of the entire intestinal tract In caecum are numerous streaky mucosal hemorrhages

The pancreas is normal in the gross Near the tail of the pan-

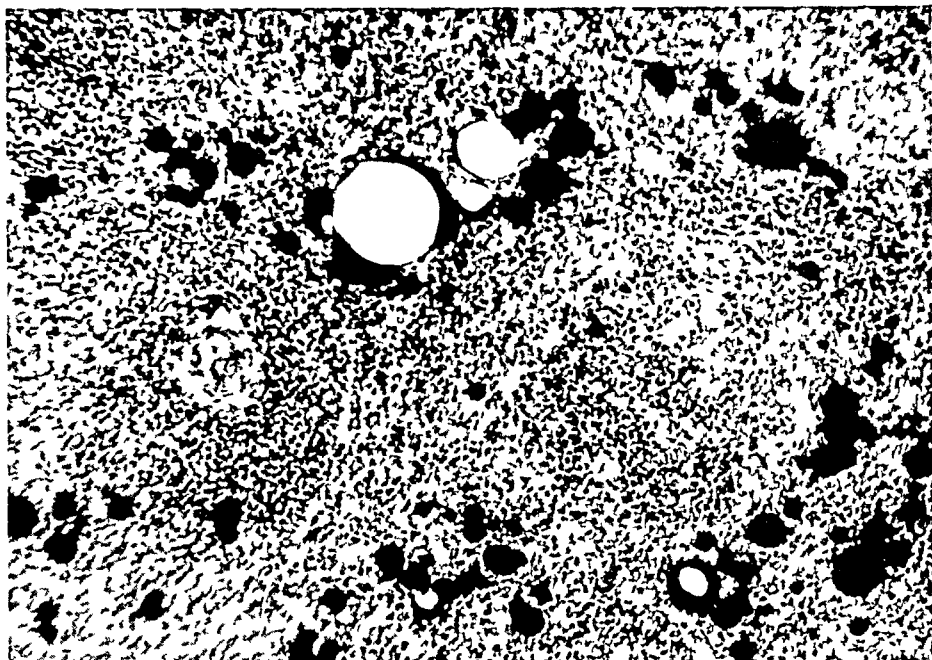


FIG 4—Case I Spleen Scharlach R and hæmatoxylin showing tendency for the emboli to group themselves about the periphery of the Malpighian bodies

creas is a lymph-node, 1 cm in diameter, showing much central caseation The liver weighs 1780 gms The cut surface is opaque, and the markings are indistinct The gall-bladder and ducts are normal The weight of each kidney is 150 gms The vessels at the junction of the cortex and medulla are injected The adrenals appear normal In the mucosa of the bladder, mostly about the neck, are numerous small hemorrhages

Brain The weight of the brain is 1580 gms There is the slightest suggestion of a cerebellar pressure cone, and the uncus projects into the interpeduncular fossa somewhat more prominently than normal There is no other gross evidence of œdema, and no hemorrhages are seen

*Microscopic Examination*—Heart There are numerous small areas of hemorrhage in which large numbers of fat emboli may be seen The emboli often appear as long cords, and their diameter varies with that of the vessel in which they are lodged The cells surrounding small groups of emboli often show considerable fatty degeneration Phagocytic cells are not noted in such areas Interstitial œdema and congestion are extreme These changes are most marked in the left ventricle

Lungs Fat emboli are exceedingly numerous in the lungs The alveolar walls are congested and most of the capillaries are stuffed with fat A small amount of free fat is present in the alveoli The alveoli are, in most instances, filled with transudate, but there is also considerable hemorrhage There is a small amount of hæmosiderin in the alveoli, some of which has been phagocytosed There is an acute bronchiolitis and also small patches of early bronchopneumonia The exudate consists almost entirely of polymorphonuclear leucocytes, a small amount of fibrin and a few macrophages





these areas. There is little or no phagocytosis. Areas of degeneration are seldom seen in the fibre tracts. The remainder of the brain tissue is extremely oedematous.

CASE II—W. L., aged twenty-one, was a healthy young man of good habits. At 2 A. M., on April 29, 1923, he fell from a window, a distance of 30 feet, and struck on the pavement, sustaining a closed fracture of the left hip and a compound comminuted fracture of the right humerus. He was removed at once to the Troy Hospital, where he was seen by Doctor Elting at 10 A. M. The fractures were carefully immobilized and the patient removed to the Albany Hospital, where he was admitted to the surgical service at 12 noon on May 1. At that time he appeared to be somewhat pale and shocked but quite rational.

The temperature was 98.8°, pulse 120, and respirations 23. The patient was placed in a fracture bed and extension applied to the left leg. The right upper arm presented an irregular wound about 10 cms. in length, situated on the external surface at about the mid-region of the arm and just over the site of fracture of the

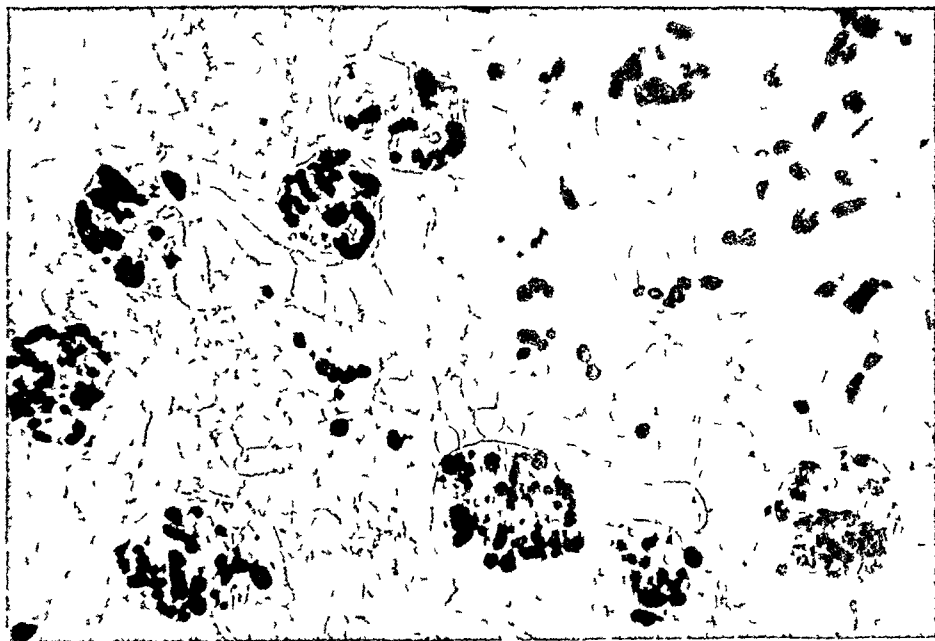


FIG 6—Case I. Kidney. Osmic acid preparation. Fat emboli in the glomeruli and extra-tubular capillaries.

humerus. Wet antiseptic dressings were applied and the arm immobilized. There were numerous contusions of the chest and abdomen, but none of the head. The patient was restless and uncomfortable, but his condition remained fairly satisfactory. The temperature was practically normal for three days, and the pulse ranged from 90 to 100. The respirations were about 25, and there were no cerebral, cardiac or respiratory symptoms of any significance. For the first two days the patient was restless and difficult to manage at times, but on the third day the general condition was much improved. He was less restless, quite rational, and sleep was more natural. Early on the fourth day the temperature rose in a few hours to 104°, the pulse to 140, and the respirations to 35. The patient was at first restless and delirious, but later in the day he became stuporous and during the night lapsed into coma. When seen on the morning of the fifth day the temperature was 105°, the pulse 150, and the respirations 40. He was quite comatose, with Cheyne-Stokes respiration. The reflexes were abolished. The breathing was labored. Cyanosis was pronounced, and there was evident pulmonary oedema. The pulse was weak and the arterial pressure low. The eye grounds were negative. The wound on the right arm was unchanged except for a slight amount of sero-purulent discharge. Cultures from this wound made on the fourth day showed a hæmolytic streptococcus and a hæmolytic staphylococcus aureus. Blood cultures made on the fourth day were negative. Urine examination showed some albumin, a few granular casts and a few red blood-cells. Unfortunately no special examination was made for free fat in the urine. The temperature, pulse and respiration remained elevated. The coma continued, and the patient died on the evening of the fifth day, approximately four and three-fourths days after the accident.

Autopsy performed by Drs. V. C. Jacobson and L. Sutton, one and one-half hours post-mortem.

The body is that of a well-developed and well-nourished young, white, male adult, 183 cm in length. There are numerous petechial hemorrhages in the skin and conjunctivæ. These hemorrhages are most marked over the anterior abdominal wall, chest and arms.

Over the outer aspect of the right arm is a laceration 3 x 1 cm. It is several centimetres in depth, and from it a blood-stained, turbid fluid exudes. The tissues for several centimetres about are œdematous and indurated. A comminuted fracture of the humerus, with much crepitation, can be easily felt just beneath the surface. Numerous



FIG. 7.—Case I. Pancreas. Scharlach R and hæmatoxylin. In centre is an islet of Langerhans swollen, congested and containing fat emboli.

blebs with a reddish base are scattered over the outer surface of the lower half of the arm. The circumference of the right arm is 30 cm and of the left arm 25 cm.

The left femur is fractured at about its middle. Measuring from the anterior superior spine of the ileum to the internal malleolus, the left leg is 91 cm and the right leg 99 cm in length. Beginning 4 cm below

the right iliac crest is a large area of ecchymosis and yellowish discoloration 29 x 14 cm. There are various ecchymoses of the right knee, right leg and left leg.

An extensive hemorrhage in the pelvis covers the bladder, sigmoid and psoas muscles. There is about 10 cc of free blood in the pelvis. In the anterior abdominal wall is a diffuse retro-peritoneal hemorrhage and the peritoneum shows a few small lacerations. The mesenteric lymph-nodes are enlarged, some of them being 2½ cm in diameter.

The left pleural cavity contains 50 cc of thin, reddish-brown fluid and the right cavity 10 cc of blood. The pericardial cavity and heart are apparently normal.

The lungs are acutely congested throughout, but more so in the lower lobes. Projecting above the surface of the lower right lobe is a bleb 3 cm in diameter, filled with blood. Within the substance of the lung are several similar pools of blood. There are no large hemorrhages in the left lung, but digestion of considerable tissue about the hilum has occurred from a perforation in the œsophagus. Many of the bronchioles contain a mucopurulent material.

The spleen (370 gms) is grayish-red, firm, and the lymphoid follicles prominent. The lower two-thirds of the œsophagus is thin and necrotic. An agonal perforation which communicates with the mediastinum and left pleural cavity has occurred in the middle third.

The liver weighs 2150 gms. The cut surface is opaque. In the right lobe are several linear fractures, 4 to 6 cm in length, filled with clotted blood. The surrounding tissue is necrotic. The kidneys are congested. The adrenals, bladder, genitalia and aorta appear normal.

The brain is congested and œdematous. There are pin-point hemorrhages diffusely distributed throughout the gray and white matter of the cerebrum, cerebellum, pons and basal ganglia.

## FAT EMBOLISM

*Microscopic Examination*—Heart Fat emboli are scattered throughout the myocardium. In many instances they form small groups about which the muscle fibres have undergone fatty degeneration. Rarely is there any phagocytosis. There is congestion and interstitial œdema. Leucocytic thrombi are present in several of the coronary vessels and necrosis of the adjacent muscle fibres has occurred.

Lungs Massive hemorrhage has disrupted the lung tissue, the blood filling the alveoli and bronchi. Fat emboli are exceedingly numerous, being located principally in the alveolar capillaries. There is a small amount of free fat in the alveoli. The alveolar walls are intact. Hæmosiderin-laden phagocytes are numerous. There is a slight purulent bronchitis and polymorphonuclear exudate about some of the hemorrhages.

Spleen There is an acute splenitis of the hyperæmic type. Fat emboli are numerous and located chiefly in or about the lymphoid follicles.

Liver Fat emboli are numerous in the small vessels of the periportal spaces. Fine fat droplets are abundant in the liver cells along the bile capillaries. There are large areas of necrosis, sometimes

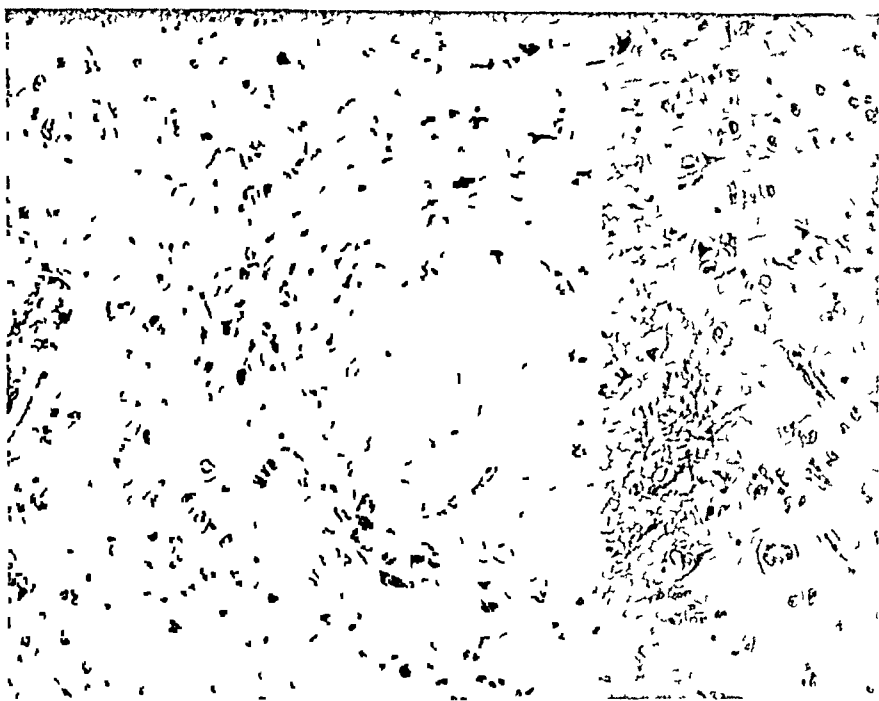


FIG 8—Case I. Frontal lobe. Hæmatoxylin and eosin. Focal necrosis with vacuolization and rarefaction of the area. The cells are shrunken and pycnotic. There is no phagocytosis.

involving whole lobules or the periportal portions, but mostly of irregular size and shape. Phagocytosis by polymorphonuclear leucocytes is in progress in small foci. Rents in the liver-tissue, probably from trauma, are filled with blood.

Pancreas Fat emboli are most numerous in the Islets of Langerhans. There is slight œdema and congestion.

Gastro-intestinal Tract Fat emboli are most often seen in the capillaries of the submucosa. The mucosa of the duodenum shows a mild acute inflammation.

Kidney Fat emboli are abundant in the glomeruli, which are swollen, congested and often contain an excess of polymorphonuclear leucocytes. There is an acute tubular nephritis and interstitial leucocytic infiltration is conspicuous in many places in the medulla and cortex.

Adrenal The cortex has undergone considerable fatty degeneration with necrosis and disappearance of many cells. There are many emboli, some of large size, principally located deep in the cortex.

Skin of Arm There is a purulent inflammation of the skin and subcutaneum, with tracts of exudate dissecting between the muscle and fascia. Fat emboli are unusually abundant, some large vessels being completely occluded.

Brain Several sections of the cerebral cortex, cerebellum, pons and bulb are examined. In all sections fat emboli are present. There are many small foci of necrosis. Some foci show simply rarefactions with destruction of myelin and pycnosis of the cells. In other areas hemorrhage alone is most prominent. Some foci of necrosis are surrounded by a rim of hemorrhage. Phagocytes are not common. Often the centre of a

necrosed area is occupied by a vessel plugged with fat. Emboli are less prominent in the fibre tracts. Several small hemorrhages are noted in the floor of the fourth ventricle and in the cerebellum.

NOTE—Shortly before death, cultures of the material from the wound in the right arm showed the presence of hæmolytic streptococcus and hæmolytic staphylococcus aureus. The autopsy findings were regarded as typical of streptococcus septicæmia, although unfortunately a blood culture was not made after death. The focal lesions so widely distributed in the body, the bronchopneumonia with hemorrhage and the bacteriological

findings in the arm wound seemed sufficient for a diagnosis of probable septicæmia.

After Case I was revealed as one of fatal fat embolism, Case II was studied from the same angle and proved to be one of fat embolism, the focal lesions being not due to bacterial emboli, but to occluding fat droplets.

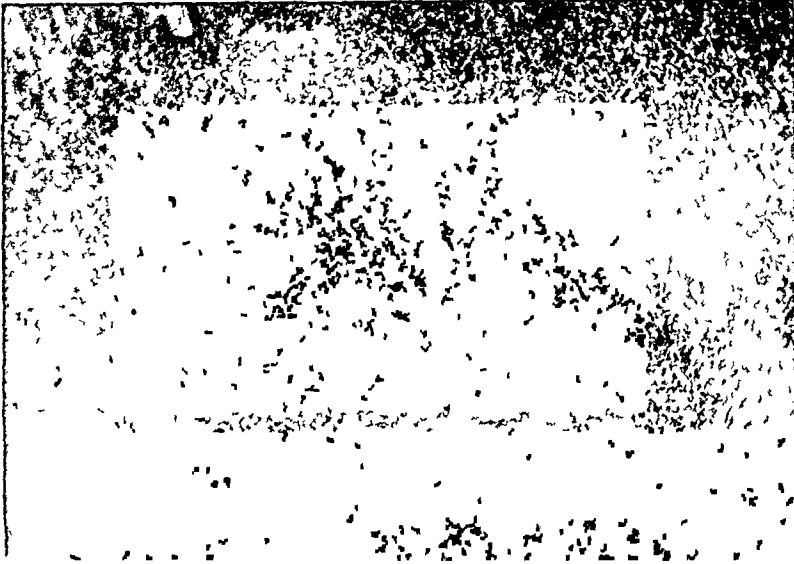


FIG. 9.—Case I. Motor area. Osmic acid preparation. Semi-confluent focus of necrosis.

There has been a remarkable tendency to regard cases of fat embolism as cases of shock, and it would appear that this term has borne the brunt of the incorrect diagnoses. W. T. Porter, of Boston, in 1917, both asserted and demonstrated that the so-called shock following war wounds of the long bones was in the great majority of instances due to fat embolism. His experiments conclusively proved that all of the symptoms of shock could be readily caused by fat embolism of the lower structures of the brain, the clinical and pathological pictures presented by his experimental animals being exactly the counterpart of those observed in the human subject. Porter further demonstrated in 1919, that the injection of a very small amount of olive oil into the vertebral artery of animals would cause fat embolism of the vaso-motor centre, thus bringing about vaso-motor paralysis and shock. Porter even went so far as to declare that fat embolism is the most frequent cause of wound shock upon the battlefield. The amount of fat which may be found in the capillaries is at times astounding, and it is difficult to conceive of where all the fat comes from. There is, furthermore, no definite relationship between the amount of trauma and the extent of the fat embolism. As a rule the trauma is rather severe, but in some instances it is comparatively trivial.

It is not altogether uncommon for surgeons to lose cases of fractures of the long bones a few days after the accident when everything appeared to

be going well. The temperature, pulse and respiration begin to rise. The patient becomes at first restless, then perhaps delirious, then comatose and death ensues. The surgeon usually regards these as cases of shock, toxæmia, infection or concussion, but they are practically always cases of fat embolism.

It is probable that fat embolism in the absence of infection is the most common cause of death after fracture of the long bones.

Waithin has especially emphasized the medico-legal importance of fat embolism after injuries in which the usual diagnosis by the coroner's physician is shock, apoplexy, alcoholism, concussion, heart disease, etc. It may be positively stated that fat embolism occurs only during life, and its presence in the body after death is presumptive, and in the majority of cases, positive evidence of trauma before death.

Fat emboli are bland, and their effects are purely mechanical. For their production three conditions must be fulfilled:

1. The fat must be liberated from the fat cell.
2. It must be liquid and accessible to the circulation.
3. There must be some force to drive it into the blood-vessels.

Trauma and the accompanying hemorrhage, with at times infection, easily bring about the liberation of fat from the cell. The second condition is met by the patent vessels in the bone-marrow, and Haversian canals, which show much less tendency to close after trauma than do other vessels. Hemorrhage, cedema, inflammation, manipulation or tight bandages may readily supply the increased pressure to force the free fat into the vessels. The amount of fat which may be, and in fatal cases usually is, deposited in the capillaries is apparently out of proportion to what would be regarded as the normal amount of fat in the traumatized area. Some observers have thought there must be some other source for the free fat, but none has as yet been demonstrated.

In an effort to determine whether or not the fat content of the organs was actually increased, the lungs and spleen of the two cases of fat embolism and the same organs of five other diseased states were extracted. The lung was chosen because most of the fat must at some time pass through or lodge

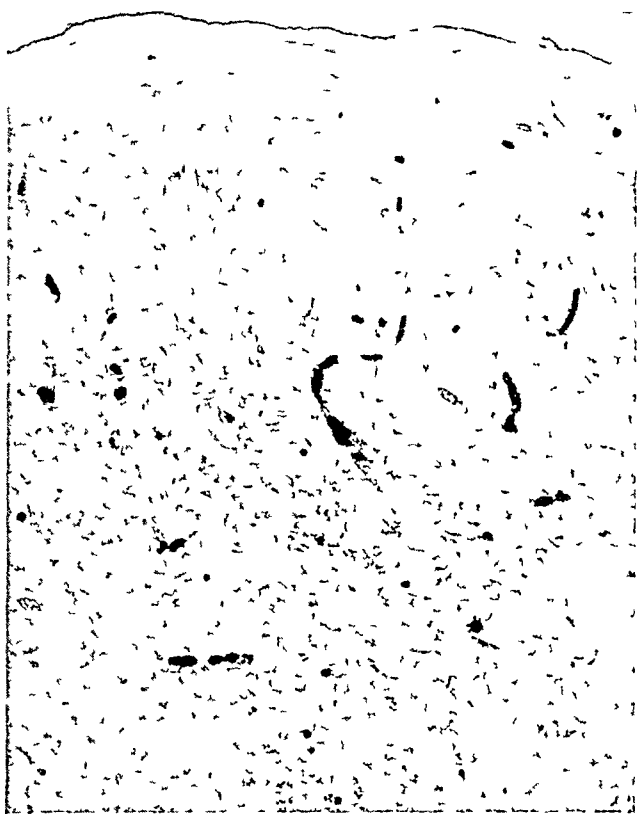


FIG 10.—Case I. Occipital lobe cortex. Schärlach R and hæmatoxylin. Numerous fat emboli. An area of focal necrosis is surrounded by several large emboli.

in it As the spleen may be considered a filter in the systemic circulation, it was also extracted

The tissue was first dehydrated over concentrated sulphuric acid, then powdered, weighed and mixed with fat-free plaster-of-Paris Using sulphuric ether as solvent, the fat was extracted by means of



FIG 11—Case I Section lateral to the Sylvian aqueduct at the level of the third nerve Scharlach R and hæmatoxylin Large focal necrosis with many emboli in and about it

the Soxhlet apparatus Extraction was continued for at least 20 hours in every case After extraction the filtrate was diluted to a known volume [usually 100 cc] and 10 cc placed in a weighed crucible The ether was then evaporated and the crucible again weighed From this the fat

content of the whole and the percentage composition of the dehydrated specimen was computed The following are the estimations

Disease	Lungs	Spleen
Fat embolism [Case I]	45.5%	52.5%
Fat embolism [Case II]	35.4%	29.1%
Extensive superficial burns [live]	3.5%	3.4%
Acute alcoholic poisoning	11.7%	8.7%
Fracture of skull with maceration of brain	13.8%	12.1%
Peritonitis following bullet wound	9.1%	23.8%
Peritonitis following perforation of jejunum	8.1%	19.0%
Normal content [Wells]	17.3%	14.2%

This, so far as we are able to learn, is the first actual demonstration of the quantitative increase of fat in the organs of cases dead of fat embolism and confirms the microscopical findings What is true of the lungs and spleen will naturally hold true of the other organs

Welch states that fat embolism is the commonest form of embolism It is our feeling that all fractures involving the fatty marrow of bones are probably associated with some degree of fat embolism, but that in the great majority of cases the embolism is so slight that no symptoms are produced, while in a lesser number of cases true symptoms do result which are usually incorrectly interpreted

In all of these cases recovery takes place, and in only a few of them may it be possible to prove the diagnosis In the cases that result fatally,

## FAT EMBOLISM

however, a carefully performed autopsy will always demonstrate a most striking and characteristic picture and one that cannot possibly be confused with any other known pathological condition

Fat embolism may be caused—

1 By all forms of trauma affecting the marrow of bones, especially fractures

2 All kinds of operations upon bones, especially the so-called orthopaedic operations

3 Trauma, inflammation, necrosis or operation upon fatty tissue in any part of the body

Fat embolism resulting from other causes is rare and of pathological interest only, as there are rarely any definite symptoms

The vast majority of cases of fat embolism are due to trauma of the bone and are most frequently observed after injury to the bones containing the greatest amount of fatty marrow, as the femur, tibia and humerus. The osteoporotic bones of the aged and the atrophic bones of any age, containing more

than the normal amount of fat, are naturally of etiological importance, but it is especially apt to occur after serious injury to the long bones of the healthy young adult, particularly in the third decade. The fat may pass into the blood stream rapidly and in sufficient quantity to produce symptoms almost immediately, although in the majority of instances the accumulation of the fat in the capillaries is a slower process, and the symptoms do not appear for some hours, it may be several days after the trauma. Tight bandages, manipulation, movement and jarring are factors which may favor fat embolism.

The oft-repeated and generally accepted observations of the lessened shock observed in the late war, as the splinting and transportation of cases

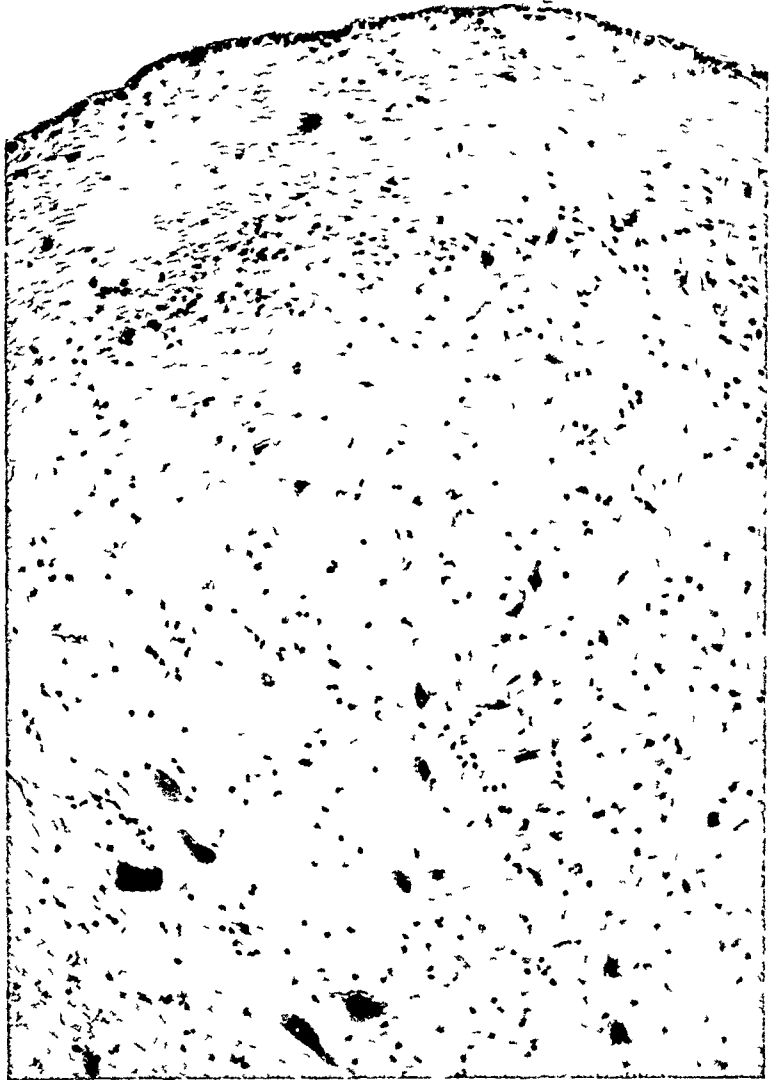


FIG 12—Case I. Floor of the fourth ventricle. Hematoxylin and eosin. Large area of rarefaction occurring in the nucleus of the hypoglossal nerve. The ganglion cells show various stages of degeneration.



of fracture became more expert, skilful and expeditious, furnish in our judgment not only clinical evidence of the importance of fat embolism as a cause of the so-called shock in these cases, but also striking evidence of the importance of prophylaxis in possible cases of fat embolism. There can be little doubt that many cases of death from so-called post-operative or traumatic shock are cases of fat embolism, for unless autopsies are conducted with this possibility in view, many, if not most cases, of fat embolism will be overlooked.

The manner in which fat droplets produce embolism has been much

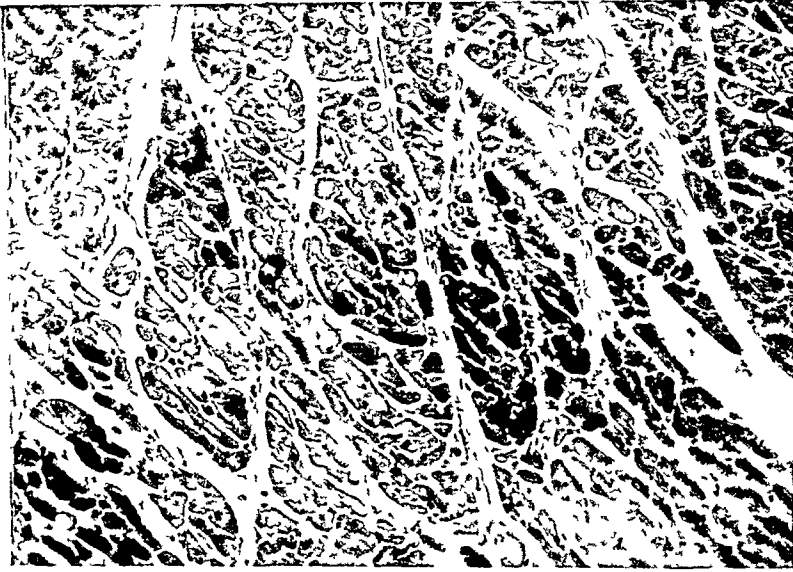


FIG. 13.—Case II. Heart. Schärlach R. and hæmatoxylin. Area in centre undergoing fatty degeneration: several emboli, œdema and congestion.

discussed. Gauss, by adding olive oil to citrated human blood, claims to have increased its viscosity approximately four times. This was confirmed by Bissell. In attempting to repeat these experiments we were at once confronted with the extreme difficulty of keeping

the fat droplets in the emulsion of sufficient size to form emboli in a capillary tube. When they were of large size and could be induced to enter the capillary tube, the findings agreed with those of Gauss and Bissell, and even when a single droplet of fat was made to enter a capillary tube ahead of a column of normal salt solution, the time for the passage was increased to the same degree as was originally found. Obviously the apparent increase in viscosity was due, not to the increased viscosity of the whole mixture but to the presence of the fat alone. In an effort to make the fat remain emulsified, it was shaken in a mechanical shaker, and to aid in the emulsification ground glass was added. When this was done and the viscosity tested it was found not to be increased over that of the salt solution without fat. In this case the emulsion was very fine and did not settle out.

The latter finding is, of course, not new and only serves to bear out what has long been known in lipæmia, as of diabetes, where there is an extremely fine emulsion of fat and blood and in which fat embolism does not occur. So it is that from these experiments we believe that while the progress of fat emboli through a capillary may be slow or even halted, it is due to the greater viscosity of the fat alone, rather than to the increased

## FAT EMBOLISM

viscosity of the whole fluid. These experiments were performed both with olive oil and human fat. Olive oil has a somewhat greater viscosity than human fat.

The characteristic lesions of fat embolism are widespread throughout the body, and a knowledge of the pathology is absolutely essential for a proper interpretation of the clinical phenomena. At the site of the injury or operation liquid fat is found often mixed with blood or pus. This fat enters the more or less patent veins, especially those of injured bones, aided by the increased tension at the site of the injury. In addition to the fat which enters the blood-vessels, fat may also enter the lymphatics, pass through the regional lymph-glands, and reach the venous circulation through thoracic duct.

The lesions which occur depend upon the amount and the distribution of the fat which enters the circulation. The fat appears to be first arrested chiefly in the pulmonary capillaries, and in many instances it may go no further, but as the fat increases in pulmonary capillaries it passes into general circulation, then it is that a widespread distribution takes place, and there are no organs or tissues which may not show fatty embolism.

It is probable that a considerable amount of fat can be tolerated in the capillaries without necessarily producing serious lesions. If the fat enters the heart in large amounts the result may be very similar to that observed in an embolism. The heart action may not be sufficient to drive the fat into the lungs, and serious embarrassment of the heart and death may ensue. The heart action and function are also seriously and even irreparably impaired by myriads of capillary fat emboli in the terminals of the coronary arteries causing large numbers of small cardiac infarcts and it is probable that most of the cardiac symptoms are due to this condition. Liquid fat may be observed in the right heart, and numerous petechial hemorrhages occur

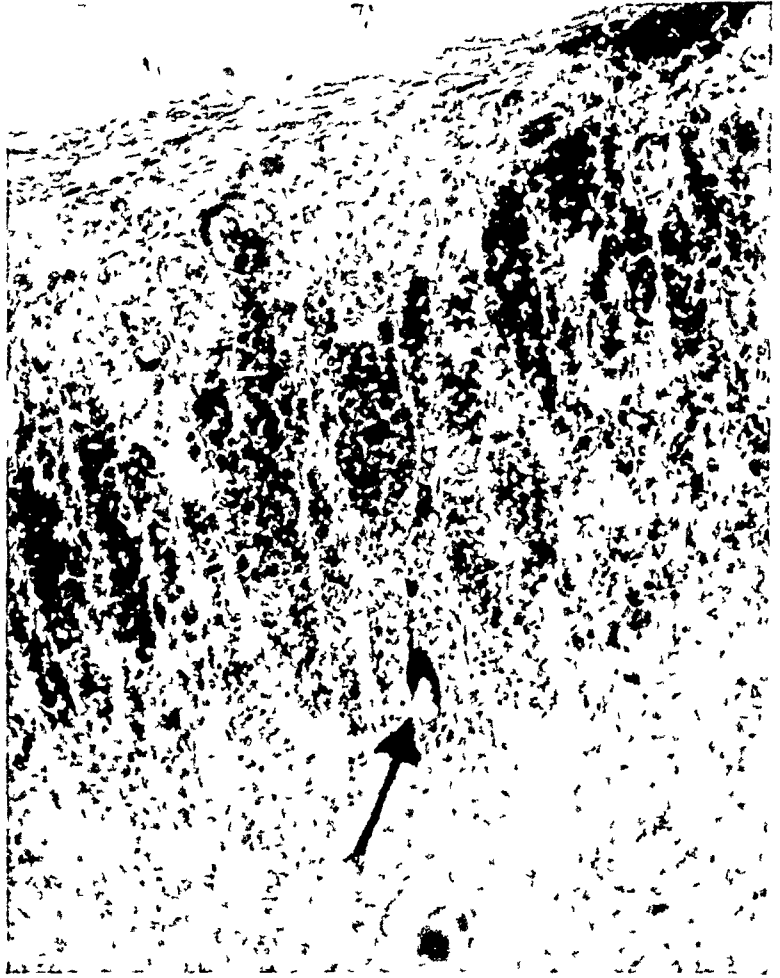


FIG. 14.—Case II. Adrenal. Scharlach R and hematoxylin. Extensive fatty degeneration of the cortical cells. The arrow points to a large embolus.

beneath the epicardium and endocardium, surrounded in some instances by a small rim of light yellow discoloration. Microscopically, the emboli seem to group themselves in colonies, and around these emboli the heart muscle shows fatty degeneration and anæmic infarcts.

The pulmonary capillaries receive by far the largest number of fat emboli. The lungs at autopsy are rather firm, and a thin blood-stained fluid drips from the cut surfaces, while fat droplets may be seen in the blood-vessels. Œdema, congestion, hemorrhage and rarely hemorrhagic infarction are seen. Subpleural hemorrhages are often observed. Microscopically the lungs present in addition,

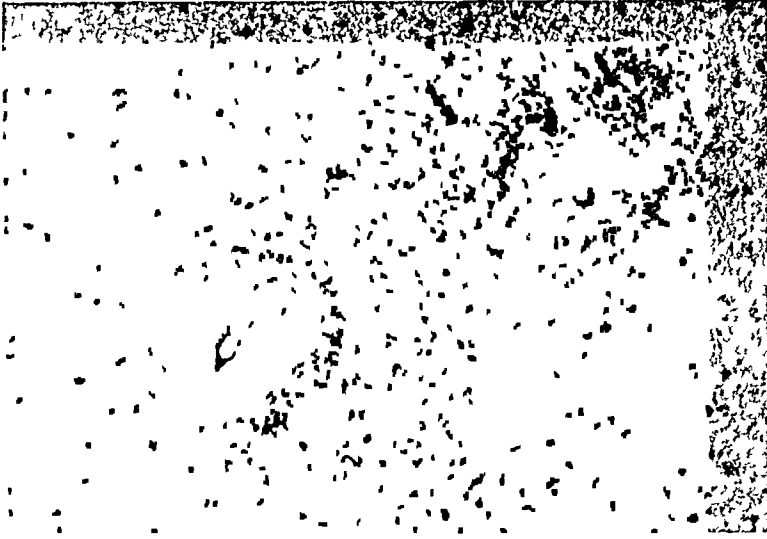


FIG. 15.—Case II. Cerebral cortex. Scharlach R. and hæmatoxylin. Two areas of focal necrosis, each containing a fat embolus.

when stained with Scharlach R or osmic acid, capillaries greatly dilated and filled with fat which may be in a globular or confluent form.

The brain in the gross usually is the picture of cerebral œdema. Scattered milium hemorrhages are evident on the surface, as well as throughout the sub-

stance of the brain. Microscopically, minute hemorrhages are found around small vessels filled with fat. The surrounding brain tissue shows more or less pronounced degeneration characteristic of focal necrosis or infarction.

These lesions adequately explain the early cerebral irritation followed by the paralysis so characteristic of the cerebral syndrome.

The spinal cord presents similar, though less striking lesions.

The liver shows passive congestion due to the heart impairment, and there are minute areas of focal necrosis. Fat emboli may be observed in the capillaries surrounded by areas of cell degeneration.

The spleen is usually swollen and congested. The fat emboli are particularly abundant and tend to group themselves around the Malpighian bodies.

The kidneys are congested. The fat emboli are found especially in the glomerular capillaries, and are much less evident in the vessels about the tubules. There are often fatty casts in the tubules. Small hemorrhages may be present, but degeneration of the renal cells is usually slight.

The petechiæ observed in the skin are the result of minute hemorrhages around capillaries filled with fat.

The pancreas shows numerous fat emboli, chiefly in the capillaries of the islands of Langerhans.

## FAT EMBOLISM

The adrenals show many emboli in the capillaries of the cortex, with marked degeneration of the surrounding cells

The thyroid, striated muscles and in fact all the other tissues show more or less pronounced capillary fat embolism

The excretion of the fat is largely through the kidneys, and numerous clinicians have noted its presence in the urine. Fat is also excreted through the activity of the phagocytes, and as Warthin first emphasized, many of these

fat-laden phagocytes appear in the sputum, a diagnostic point to which he called special attention

Through the intestine, bile and other channels the fat-laden phagocytes may make their escape. Very small amount of the fat may be taken up by cer-



FIG. 16.—Case II. Inferior olivary body. Scharlach R. and hematoxylin. Capillaries of the convolutions containing numerous emboli.

tain of the fixed cells of the body, and it is probable that a small portion of it is also disposed of through the processes of oxidation and saponification

A study of the clinical features of fatal cases of fat embolism shows the striking uniformity with which certain symptoms appear. There seems to be a fairly well defined clinical picture and one which should be recognized. Following trauma most commonly associated with fracture of a long bone, or an operation upon the bones or fatty tissues, there is usually a period of well-being during which the patient's condition is fairly satisfactory. This euphoria may last from a few hours to a week or more.

As a general rule the symptoms due to fat embolism are first observed on the second or third day following the trauma or operation, although they may occur within a few hours or be deferred for several days. As a rule the earlier the symptoms present, the more serious the case, and the more certain the fat embolism.

The symptoms may be classified into two general clinical syndromes, although these merge into one as the fatal termination is approached. (1) The cardio-respiratory syndrome and (2) the cerebral syndrome. Some writers attempt to differentiate a cardiac from a pulmonary syndrome, but we believe from a study of the clinical phenomena and the pathological findings that they should be classed as one symptom complex in which, unlike

most writers, we regard the cardiac phenomena of more importance as a rule than the pulmonary. The chief symptoms are dyspnoea, cough, cyanosis, pulmonary oedema, occasional pulmonary hemorrhage, rapid and irregular pulse with a low arterial and high venous pressure. There may be cardiac dilatation and precordial distress. The temperature is at first as a rule not elevated, but

as the case progresses, it may reach  $103^{\circ}$  or more and usually continues high until death. Cheyne-Stokes respiration is often present. Moist râles are often heard over the lungs from evident pulmonary oedema, and at times the sputum is very profuse. As a rule there is little impairment of the pulmonary resonance associated with pure fat embolism.

The cardio-respiratory syndrome is the one which usually develops first, but if the case progresses, the second cerebral syndrome comes strikingly into evidence, although it may appear within a few hours after the trauma or operation. The constant features of this syndrome are at first restlessness,

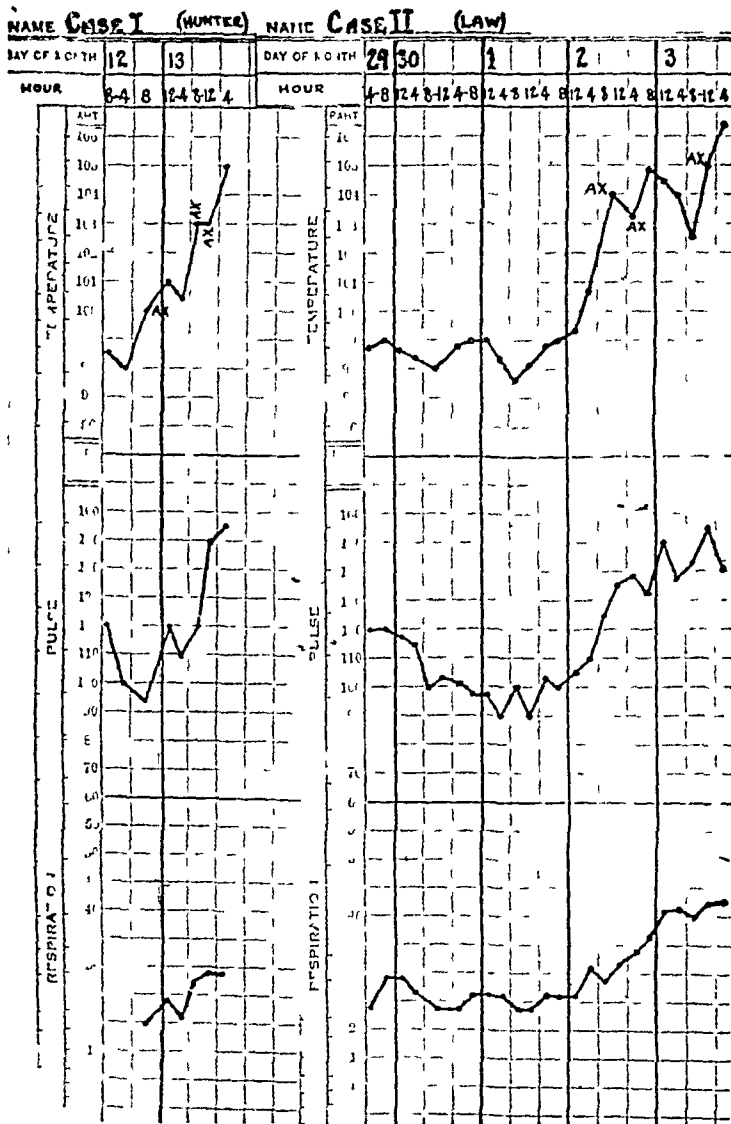


FIG. 17—Charts of the two fatal cases

often headache, more or less delirium, sometimes hallucinations, then drowsiness, stupor, and finally coma, which persists until death. The reflexes may or may not be abolished, and there may be spasms, tremors or convulsions. The earlier cerebral symptoms are those of cerebral irritation coincident with the occurrence of the showers of emboli, while the later symptoms are those of paralysis, due to the rapid cerebral degeneration. There are no signs of increased intracranial pressure, and eye grounds are usually normal. Embolism of the respiratory tract accounts for the Cheyne-Stokes respiration. Embolism of the heparulating mechanism

may explain much of the elevated temperature, while embolism of the vasomotor centre may cause many of the apparent symptoms of shock. The pupils are usually rather small but equal. Petechiæ may be observed in the skin but are more or less obscured by the cyanosis and are at any rate of relatively late appearance.

The symptoms described characterize the fatal cases, but they may be seen in milder form in cases that recover, and it is quite evident that this picture closely resembles what is usually regarded as shock. It is probable that careful urinary examination will always reveal some fat in the urine in severe cases of fat embolism, and it may be present in mild ones. Warthin and others have also emphasized the importance of fat in the sputum as an aid in diagnosis. In cases associated with head injury, the diagnosis may be very difficult during life, but it should not be at autopsy, as it appears to have been in the past.

The course of fat embolism may be rapid or slow. Some cases are so rapid as to be described as apoplecticiform, with death in a few hours, while others may persist for days or weeks to end in death or recovery. As a rule the longer the patient lives, the better the prognosis. In well-developed cases of fat embolism, especially those of the cerebral type, the prognosis is almost invariably bad, and the great majority of all severe cases die. One cannot judge the mortality by the literature, for most of the cases reported have been fatal ones, while it is probable that a much larger proportion recover but are not recognized as such and are classified under various headings. Post-operative or post-traumatic diagnosis of bronchitis and pneumonia may not infrequently be rather fat embolism.

The treatment of fat embolism is chiefly prophylactic. All cases of trauma, especially fractures, should have absolute rest, and all unnecessary movement or manipulation should be avoided. Transportation of such a case should be with the greatest care. Tight bandages should not be used. All unnecessary trauma should be most carefully avoided in operations, whether of orthopaedic or other character. None of the methods of treatment so far proposed seems to be of any especial value, the reason for which becomes apparent when one studies the pathology of the condition. Venesection, saline injection and thoracic duct fistula are the chief measures hitherto recommended, but the results of their employment are by no means encouraging. Symptomatic treatment is in general about all that can be proposed. It is hoped, however, that as surgical attention is directed more and more to the importance of this condition, effective methods of treatment may be devised.

## REFERENCES

- Welch, William H. Albutt's System of Medicine, chapter "Embolism" which Contains Reference to Virchow's and Zenker's Contributions.  
 Warthin, Aldred S. Inter Clin. Phila., 1913, 23 s., vol. iv, p. 171.  
 Porter, William T. Bost. M. and S. J. 1917, vol. clxxvi, p. 248. *Ibid.* 1919 vol. clxxx, p. 531.  
 Gauss, H. Arch. Int. Med., 1916, vol. xxvi, p. 76.  
 Bissell, W. W. Surg. Gyn. and Obs., 1917, vol. xxv, p. 8.

## OPERATIVE TREATMENT OF ANGINA PECTORIS\*

BY HARRY HYLAND KERR, M D , C M

OF WASHINGTON, D C

THE interest of the medical world has recently been aroused by the attempted surgical relief of angina pectoris. There are recorded in the literature sixty-three cases in which various surgical procedures have been performed to relieve this ailment. With the additional eight cases herewith reported, we have sufficient data from which to gather certain tentative deductions.

The rationale of the operative procedures used is based on Sir Clifford Allbutt's theory of the nature of angina pectoris. Contrary to the older teachings, he believed that the disease is primarily in the first portion of the aorta and that the heart itself or its coronary arteries may be entirely uninvolved. The characteristic lesion is an aortitis involving the outer, rather than, the inner coats of the vessel. Through the fibres of the cardiac plexus, this aortitis sets up a reflex spasm of the aorta when subjected to strain. The root of the aorta first feels the blunt of increased heart action and the nerve fibres in its adventitious are irritated. Through the afferent nerve tracts this irritation stimulates the centres in the cord or the medulla. Through the efferent fibres the muscular walls are thrown into contraction. The subjective manifestation of this spasm is the agonizing substernal pain referred down the left arm. It is probable that the pain always accompanies a contraction of the vessel. The attack can be arrested and relief obtained if the vessel is made to dilate. Clinical experience indorses the theory, in that the most efficacious drugs used during the attacks are the vaso-dilators as nitroglycerine or amyl-nitrate. As these drugs relieve the attacks, surgery has attempted\* to prevent them. As the attack is the manifestation of an aortic spasm, the result of a physiological reflex, it can be prevented by dividing either the efferent or the afferent fibres of the reflex arc.

The heart is innervated by the superficial and deep cardiac plexuses with their branches, the anterior and posterior coronary plexuses. The superficial cardiac plexus is made up of the left superior cardiac nerve from the left superior sympathetic ganglion and branches from the vagus and filaments from the deep cardiac plexus. It is distributed to the base of the aorta, the atria, and the anterior coronary plexus. The deep cardiac plexus is made up of other cardiac nerves from the right and left sympathetic ganglia and the vagi.

A greater part, if not the greatest part, of the nerve supply of the root of the aorta is from the superficial cardiac plexus. The sympathetic portion of this plexus comes principally from the left superior cervical sympathetic

---

\* Read before the American Surgical Association, May 6, 1925

## OPERATIVE TREATMENT OF ANGINA PECTORIS

ganglion through the left superior cardiac nerve. This nerve therefore, plays a large part in the sympathetic innervation of the first portion of the aorta. The depressor nerve is considered an afferent nerve of the heart. In the rabbit it occurs as a separate nerve, but in man its anatomical identity is not clearly made out. Hofer in describing his operation of the division of the depressor nerve for the relief of angina pectoris advises the resection of all branches of the vagus and superior laryngeal nerve passing into the thorax. Stimulation of the depressor nerve uniformly causes a drop in blood-

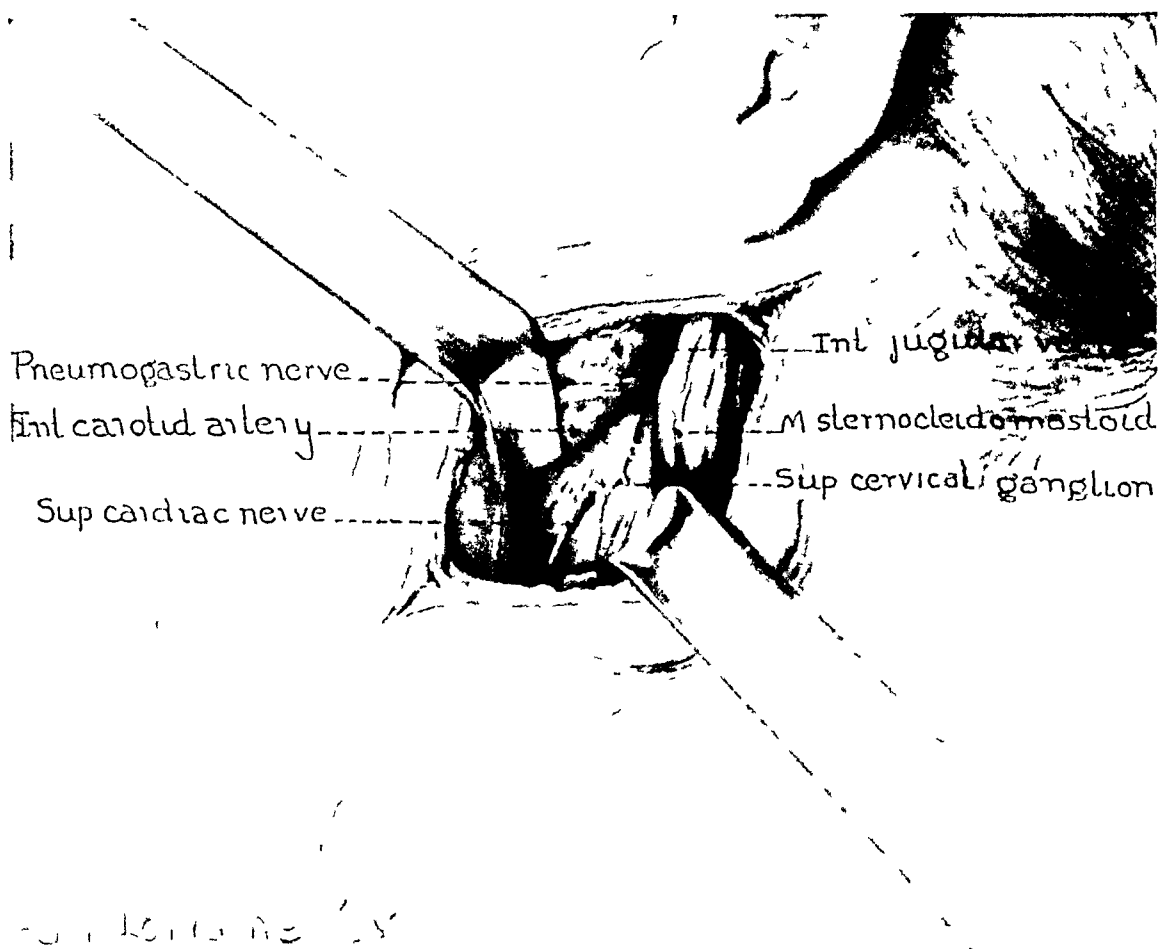


FIG. 1.—Operative treatment of angina pectoris, exposure of the superior sympathetic ganglion by an oblique incision in front of the sternocleidomastoid muscle. The superior cardiac nerve is seen passing forward and downward under the carotid sheath which has been retracted for wards.

pressure in experimental animals. If it acts in the same way in man it is probable that the depressor nerve is included in the human vagus sheath, since stimulation of the vagus near the base of the skull produces the same phenomenon. Division of either of these nerve tracks, the sympathetic or depressor nerve, would theoretically interrupt the reflex arc connecting the heart with the central nervous system.

Francois Frank suggested division of the sympathetic nerve tracks to the heart for the relief of angina pectoris. Wenckebach suggested division of the depressor portion of the vagus with the same object in view. Both procedures have been carried out in a limited number of cases with results encouraging enough to tempt us to continue our surgical efforts to relieve this terrible malady.



Seneque discusses, in a recent article, twenty-three cases operated on for angina pectoris and concludes that resection of the inferior cervical and first thoracic ganglia is the operation of choice. More recently, Mont Reid, analyzed a larger group of cases and comes to the same conclusion.

From a careful study of all cases reported and from a small personal experience, I am of the opinion that the simple avulsion of the superior ganglion offers as good results with far less risk to these cases with already damaged circulatory systems.

To simplify the study of the results of the various operative procedures, we may divide them into three groups according to the nerve tract divided.

In the first group, all the sympathetic nerves going to the heart are divided especially on the left side. This original operation of Jonnesco is a procedure of considerable magnitude, requiring especial retractors and electrically lighted instruments. Though it can be performed under local anæsthesia as in Case IV of this series, general anæsthesia has usually been resorted to. This operation or modification thereof has been performed twenty-six times. There were five deaths. Ten cases were completely relieved thereby and six partially relieved. In three, no relief was obtained and in one, the result was not stated.

The second group comprises the cases treated by division of the depressor nerve. This is a small group consisting of the cases reported by Hofer. Most anatomists consider the depressor nerve a fasciculus of the vagus and its identification must be difficult or impossible in some cases.

Of the twelve cases so treated, death resulted in two, complete relief in four, and partial relief in three. In two others the depressor nerve could not be found and no relief was obtained. In one the result was not stated.

The third group are the cases in which the left superior cervical sympathetic ganglion or the left superior cardiac nerve was divided. This procedure was first advocated as a relief for angina pectoris by Coffey and Brown, of San Francisco, and may be termed the American operation.

Thirty cases, including the eight cases herein recorded, have been so treated. The results are as follows: Deaths 5, complete relief 17, partial relief 6, failure 2. It is thus seen that the American operation gives the highest percentage of relief.

Considering the risk entailed in these cases, the advantages of the American operation over the others is most marked. The American operation is a simple anatomical dissection which should never require a general anæsthetic. The original exposure of the superior cervical ganglion advocated by Coffey and Brown was through an incision behind the sterno-cleido-mastoid but I believe the operation described by C. H. Mayo in 1914 is much the superior. Briefly its steps may be described as follows:

An oblique incision is made in a fold of the neck beginning under the left mastoid process and running forward and downward three or four inches

## OPERATIVE TREATMENT OF ANGINA PECTORIS

The anterior border of the sterno-cleido-mastoid muscle is dissected, taking care not to injure the spinal accessory nerve in the upper angle of the wound. The carotid sheath containing the carotid artery, internal jugular vein and pneumogastric nerve is then exposed and retracted forward. The superior cervical ganglion is found on the longus capitis muscle opposite the transverse process of the second cervical vertebra in loose alveolar tissue. It is best freed by gauze dissection when its connection upwards and downwards are easily made out. The superior cardiac nerve is a very constant and large branch coming off the anterior inferior part of the ganglion and passing downward and forwards under the carotid sheath. The only difficulty that might arise in the dissection is the differentiation between the vagus with its bulb in this neighborhood and the elongated sympathetic ganglia. A wider dissection, demonstrating the extension and connections of the nerve in question, will clear up this point.

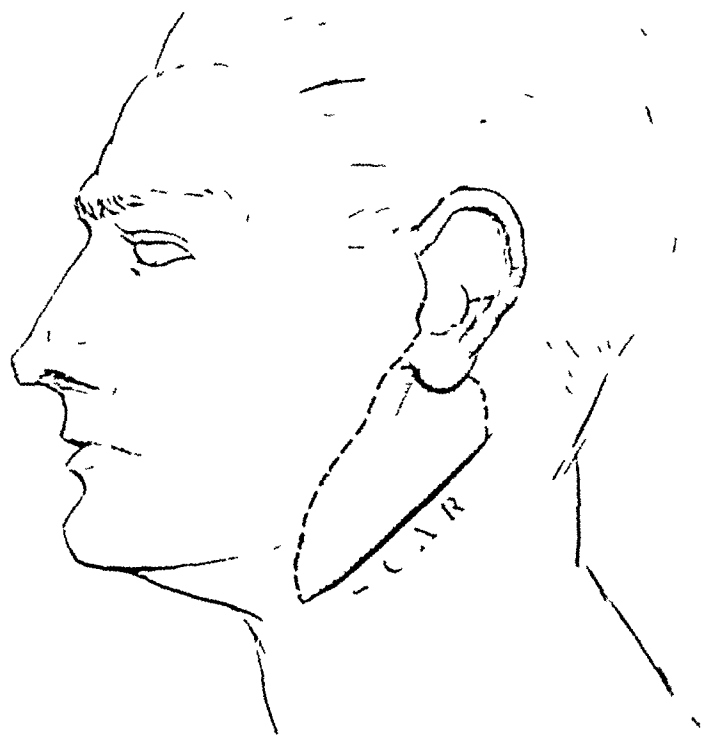


FIG. 2.—Operative treatment of angina pectoris, anesthesia produced by division of branches of the cervical plexus.

In the ten operations I have performed, I have observed an interesting phenomenon that may prove of value in making this differentiation exact. When the vagus nerve is grasped with smooth thumb forceps and gently squeezed the systolic blood-pressure drops and, with the release of the nerve, the blood-pressure resumes its former level. The pulse rate is not altered by this manipulation. Squeezing, or even tearing out the superior cervical ganglion, has no marked effect on the blood-pressure. This observation suggests that the depressor nerve is included in the vagus sheath at this level. I have demonstrated it in all but one of my ten operations. I submit it for what it may be worth.

In the eight cases in which I performed the so-called American operation the left superior sympathetic ganglion has been removed according to the foregoing technique. In two cases the operation was repeated on the right side and in one, at a third seance, the middle cervical and stellate ganglia were also avulsed under local anesthesia. In five cases complete relief from the angina was obtained, in two partial relief, and in one no relief. In those cases still having a residue of their pain in the form of a substernal ache on exertion or

effort, the relief is so great that they are restored to sub-normal activity and feel immensely repaid for their short stay in the hospital

The permanent results of superior sympathectomy are anesthetization of the area above the oblique scar, from division of the superficial branches of the cervical plexus. There is also produced an enophthalmos and contraction of the pupil on the operated side. This latter phenomenon always appears as soon as the ganglion is avulsed, but may disappear in a few hours or days. It usually persists.

In conclusion it is fair to state that interruption of the nerve pathways to or from the heart has a remarkably beneficial effect in true cases of angina pectoris.

The results of all operations show a relief either complete or partial in sixty-six per cent, a mortality of 17 per cent, a failure in only 10 per cent.

The American operation of resection of the superior cervical sympathetic ganglion under infiltration anesthesia gave as good results as the more difficult and dangerous operations proposed and should have no mortality.

It is interesting to note that no case of angina pectoris operated upon has since died of the disease as far as can be ascertained.

#### REPORT OF CASES

CASE I—A W, female, age fifty-seven. First seen January 31, 1924. Patient was a short, rather stout woman whose blood-pressure was 200/90. The examination of her blood was normal, the Wassermann negative, urine negative except for a very faint trace of albumin. Renal function test and the blood chemistry were within the normal limits. Her weight was 140 pounds.

Examination of the heart was negative, there was no enlargement and no cardiac murmurs. X-ray of the chest was negative.

Her present illness began twenty months before admission with a characteristic attack of angina pectoris. While walking up a slight incline she was seized with a knife-like pain behind the sternum, running down both arms. This experience has been repeated innumerable times since, growing worse until she finally was confined to her room by the attacks. The slightest exertion or the ingestion of anything but a small amount of liquid nourishment produced an attack. The pain responded promptly to nitroglycerine.

On February 7, 1924, under general anesthesia the left superior cervical sympathetic ganglion was removed. Following this procedure she was free from pain for two days, but it recurred on the third day, after her mid-day meal. On the fourth day she had another typical attack which was immediately relieved by nitroglycerine.

Since her pain was bilateral, February 14, the right superior cervical sympathetic ganglion was extirpated. She was discharged from the hospital, February 23, 1924, without a recurrence. Shortly thereafter while walking she had a pain which she describes as similar to her old pain. The pain was not nearly as severe and was not referred down her arms. Her subsequent history shows occasional attacks of retrosternal ache which are never referred down the arms. She has had no pain whatever for the past two months. She is able to go out and around and leads her usual life.

CASE II—W E P, age fifty-four. First seen February 26, 1924. He gave a typical history of angina pectoris of a few months' duration. The pain was referred only to the right arm and was precipitated by the slightest exercise or ingestion of food. His father died from heart trouble.

He had typhoid fever at the age of twelve years. Negative venereal history. He

## OPERATIVE TREATMENT OF ANGINA PECTORIS

used to be a heavy drinker but has been a total abstainer for the past seventeen years. In the past ten years his weight has markedly increased and he has had dyspnoea on exertion. He has never had any oedema of the legs or feet.

**Physical examination.** The patient is a large heavy man weighing about 200 pounds. His complexion is pasty and his mucous membranes are pale. The heart is found to be distinctly enlarged and a loud systolic murmur is heard over the entire cardiac area and into the left axilla. His blood pressure is 200. The physical examination is otherwise essentially negative.

On March 3, 1924 a left superior cervical sympathectic ganglion was extirpated under local anesthesia. His recovery was very prompt and satisfactory. He has never had any return of his anginal pain and a note of March 22, 1924, states that he walked a mile without discomfort. This was nineteen days after operation.

**CASE III—R. H.,** age sixty. First seen March 17, 1924. Present illness began January 1, 1924 with typical severe attack of angina pectoris. Severe pain behind the sternum referred down the left arm with a feeling of suffocation and impending death. These attacks recurred and became more severe so that he was either in bed or confined to his room.

He was a rather robust man of the florid type. His blood pressure was 140 and there was no evidence of arterio-sclerosis. Physical examination was essentially negative. X-ray of the chest showed no abnormalities of the heart or great vessels. The heart sounds were clear.

March 20 operation under general anesthesia typical block incision with extirpation of the superior cervical sympathetic ganglion and its branches. Operative recovery good. On the third day he had a sharp pain in the lower right quadrant of the abdomen. Leucocytes 13,000. His temperature rose gradually through the next several days and the leucocytes mounted to 20,000. By this time a patch of localized dullness and suspicious rales confirmed Doctor Acker's diagnosis of pneumonia. This, however, cleared up promptly and he went to Atlantic City. He had no return of his meningeal pain after operation.

In May 1924 six weeks after operation he had an attack of apoplexy of the left side which left him hemiplegic and completely aphasic. His recovery from this has not been satisfactory though he is up and around, he has never been able to speak since the stroke. He has never had an attack of angina since operation and assures me by signs that he never has it now.

**CASE IV—E. B. P.** age fifty-five. First seen October 22, 1924. He gave a



FIG. 3.—Operative treatment of angina pectoris, inconspicuous scar resulting from superior sympathectomy.

history of recurring attacks of retro-sternal pain referred down both arms for the past two years. He has never been a vigorous man, had a severe attack of appendicitis with prolonged post-operative drainage five years ago, since which time his health has been decidedly impaired. When the attacks of pain began it is said that his heart showed no abnormalities on physical examination. Since then, however, he has gradually progressed to a state of cardiac decompensation. He has been unable to lie down and spends most of his time standing by his bed-side. There is œdema of both lower extremities, involving the scrotum and both fore-arm and hands. The pulse rate is about 95. The heart is markedly enlarged, there is a systolic murmur heard over the precardium and left axilla. The aortic sound is not clear. The blood-pressure is 150. He takes nitroglycerine repeatedly. When he feels an attack coming on he puts a hypodermic tablet under his tongue and is usually able to remove it within a few seconds with the attack averted. He has been thoroughly digitalized on two separate occasions without any effect on his anginal pain or cardiac condition.

October 18, 1924 left superior cervical sympathectomy under local anæsthesia. There was some modification of his pain though it continued in lesser degree, but necessitating nitroglycerine. His pain was bilateral in distribution, so that October 25 a right superior sympathectomy was performed under local anæsthesia. Again his condition was not markedly changed and his pain continued both behind the sternum and down both arms.

November 19, one month after his first operation he was operated upon for the third time under local anæsthesia. The middle and stellate cervical ganglion of the left side were extirpated. This operation was extremely difficult because he was apprehensive during the procedure and took nitroglycerine several times. The procedure was carried out, however, without pain from the operative trauma.

Following this procedure his condition remained essentially unchanged. His retro-sternal pain continued and was referred to both arms as before. It was decidedly less severe than before the interference. Cardiac condition grew gradually worse, he was never able to lie down, his dyspnoea, tachycardia and œdema progressed and he succumbed in January, 1925, three months after his first operation.

In this case I consider that the operation was a failure. His angina was not controlled by operation, though it seemed to have been somewhat modified. He died from cardiac decompensation.

CASE V—C H F, male, age sixty-one. First seen March 7, 1925. The past history is negative except for a nervous breakdown about 30 years ago.

For the past three years he has had a feeling of soreness, distress and at times actual pain with a feeling of constriction in the upper chest and under the sternum. The pain is frequently transmitted down the arms, particularly the left. The attacks of pain have been increasing in the past few months. At present the pain is brought on by any exercise, eating or emotion. The patient is always relieved by nitroglycerine (1/200) placed under the tongue.

Heart examination eighteen months ago by Doctor Lee states: size normal, aortic arch not enlarged. First tone at apex of good muscular quality. Second pulmonic tone normal. Second aortic tone somewhat accentuated and slightly ringing in quality. A fairly loud rather harsh systolic murmur is heard at the second right intercostal space. It is heard faintly in the right supraclavicular region and at the midsternum. These aortic sounds were accentuated and the second aortic tone and murmur were increased when lying down after exercise. Cardiac response to moderate exercise good.

Examination at the present time is as above, except that the accentuated aortic tone and aortic systolic murmur are not elicited when the patient is examined at rest and are very slight after exercise. Physical findings in relation to the aorta are less marked, whereas the subjective symptom pain has become worse. The blood-pressure has remained fairly constant over the entire time, averaging about 140/80. X-ray of chest negative.

## OPERATIVE TREATMENT OF ANGINA PECTORIS

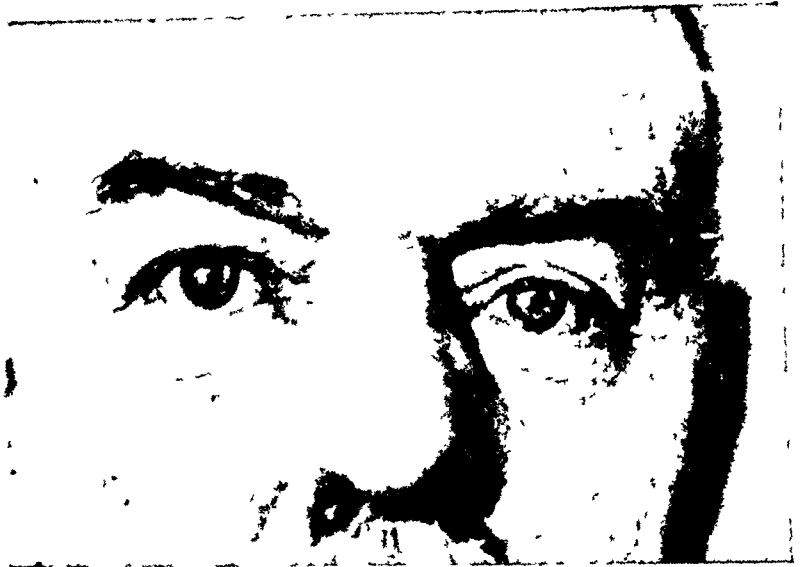
March 11, 1924, under local anæsthesia the left superior cervical sympathetic ganglion was extirpated. His convalescence was smooth and satisfactory.

Though he has had no severe attack of pain since operation, he has complained of some sub-sternal ache which has gradually diminished. At first he continued taking nitroglycerine (1/500) but as his distress gradually lessened he has practically discontinued his medicine.

The pain entirely disappeared two months after operation and has not recurred though he has resumed his former occupation.

CASE VI—T. E. M., male, age fifty-two. First seen March 13, 1925. Present illness began in December, 1924, with an attack of pain in his chest radiating to the left arm. It passed off without assistance or medication. In January, 1925, he was awakened from a sound sleep at five o'clock in the morning with a typical attack of angina. During this attack his pulse was very fast and slightly irregular. He has never had another frank attack because as soon as he feels one coming on he takes nitroglycerine and lies down.

March 16, 1925 a typical left superior cervical sympathectomy was carried out under local anæsthesia. He had a satisfactory convalescence and up to the fourth day had no return of pain.



A letter dated April 20, 1925, a little over a month since operation, states: "I have had some pain in my chest. I suppose I have taken nitroglycerine about four times, which relieved me. I have taken some light exercise in my room with no discomfort. I feel better than I have done for six months prior to operation."

CASE VII—G. D., female, age fifty-seven. First seen April 9, 1925. Seven years ago she had her first attack of severe subpectoral pain. She has had attacks more or less frequently since. For the last six months she has been confined to her room and after each attack she is compelled to stay in bed for several days. She states that she has been subject to high blood-pressure for a great many years. At present the reading is 220/110. She is a very stout woman. Her heart is somewhat enlarged and there is a loud systolic murmur heard distinctly in the aortic area and transmitted to the vessels of the neck. The diagnosis of the cardiologist, Doctor Lee, was arteriosclerosis, myocarditis with anginoid pains.

April 14, 1925, typical left cervical sympathectomy under local anæsthesia. She has had no pain since the operation. The blood pressure is decidedly lower. She has suffered from neuralgia of the left side of the head and left shoulder but has not been incapacitated thereby. She is able to climb stairs without retro-sternal discomfort.

CASE VIII—M. S., female, age fifty. First seen April 13, 1925. In 1917, she had a very severe attack of influenza with shortness of breath and some cyanosis. This left her much debilitated. She has had attacks of migraine for years. In 1918 she had an operation for appendicitis.

In 1920 the patient had her first attack of angina. X-ray taken at that time showed a slight enlargement of the arch of the aorta. There was some dullness to percussion

She was free from further attacks until about six months ago when she had a typical anginal attack. She has been having them more or less frequently ever since, having had five attacks in all.

The Wassermann is negative, urine analysis negative. Hæmoglobin 75 per cent. Coagulation time of blood 2 minutes.

X-ray interpretation is as follows. There is considerable fibrosis and calcification at the roots of the lungs and the aortic knob is unusually prominent, but there is nothing in the appearance that would represent an abnormality in a patient of this age. The heart is within normal limits.

April 14, 1925, typical left cervical sympathectomy. She left the hospital on the sixth day and up until the time of her leaving for her home she had had no return of her old pain. She has shopped, been to the theatre, and climbed stairs without the slightest discomfort.

## REFERENCES

- Arce, J. *Simana Med*, Buenos Aires, 1924, vol. xxxi, pp. 936-938.  
 Bacon, J. H. *Jour Am Med Assn*, 1923, vol. lxxvi, p. 2112.  
 Brown, P. K. *Jour Am Med Assn*, 1923, vol. lxxv, No. 11, p. 1692.  
 Blackhall, Morrison A. *Brit Med Jour*, 1920, vol. ii, p. 840.  
*Brit Med Jour*, 1921, vol. i, p. 823.  
 Bruning, F. *Klin Wchschr*, Berlin, 1923, vol. ii, pp. 777-780.  
 Bruning, F. *Deutsche Med Wchschr*, Berlin, 1923, vol. xlix, pp. 945-947.  
 Bruning, F. *Arch f Klin Chir*, Berlin, 1923, vol. cxvii, pp. 484-501.  
 Borchard, A. *Arch f Klin Chir*, Berlin, 1923, vol. cxviii, pp. 212-221.  
 Ceccarelli, C., and Campanacci, D. *Riforma Med Napoli*, 1923, vol. xxxi, pp. 1039-1042.  
 Collected Papers of 1914, p. 335, C. Mayo.  
 Coffey, W. B., and Brown, P. K. *Arch Int Med*, 1923, vol. xxxi, pp. 200-220.  
 Coffey, W. B., and Brown, P. K. *Arch Int Med*, 1924, vol. xxxiv, p. 417.  
 Danielopal and Hristide. *Bull et Mem Soc Med d'hôp de Paris*, 1923, 3S, vol. xlvii, p. 6973.  
 Danielopal and Hristide. *Comp Rend Soc de trow, Paris*, 1923, vol. lxxviii, pp. 271-275.  
 Diez, J. *Rev Assn, Med Argent, Buenos Aires*, 1924, vol. xxxvii, No. 231, Soc de Med intern, 5-33.  
 Florchen, H. *Arch f Klin Chir*, Berlin, 1924, vol. cxviii, pp. 68-92.  
 Henry, A. K. *The Lancet*, London, 1922, vol. ii, p. 1395.  
 Henry, A. K. *Irish Jour, M. S. C.*, Dublin, 1924, 5S, pp. 157-167.  
 Halstead, A. E., and Christopher, F. *Jour A. M. A.*, 1924, vol. lxxvii, pp. 1661-1664.  
 Hofer, G. *Ztschr f Hals-Nunsen*, U. Ohrench, Munchen, U. Berlin, 1923, vol. vi, p. 68.  
 Hofer, G. *Wien Med Wchschr*, 1924, vol. lxxiv, pp. 1356-1359.  
 Jonnesco, T. *Bull Acad de Med, Paris*, 1920, vol. lxxiv, pp. 93-102.  
 Jonnesco, T. *Cong Franc de Chir Proc Verb (etc)*, Paris, 1920, vol. xiv, pp. 492-500.  
 Jonnesco, T. *Bull Acad de Med, Paris*, 1921, vol. lxxv, pp. 67-71.  
 Jonnesco, T. *Bull Acad de Med, Paris*, 1921, 3S, vol. lxxvi, p. 208.  
 Jonnesco, T. *Presse Med*, Paris, 1923, vol. xxx, p. 517.  
 Jonnesco, T. *Bull Acad de Med, Paris*, 1923, 3S, vol. xc, pp. 168-174.  
 Jonnesco, T. *Presse Med*, Paris, 1924, vol. xxxii, p. 138.  
 Jennings, C. G., and Jennings, A. F. *Med Jour and Record, N. Y.*, vol. xx, pp. 311-314.  
*Journal A. M. A.*, Chicago, 1924, vol. lxxviii, p. 273.  
 Kingscote, E. *Med Times, N. Y.*, 1924, vol. liii, p. 272.  
 Kingscote, E. *Brit Med Jour*, London, 1924, vol. i, p. 914.  
 Kappis, M. *Med Klin*, Berlin 1923, vol. xix, pp. 1658-1662.  
 Kamnitzer. *Therap d Gegem*, Berlin, 1923, vol. liii, p. 234.

## OPERATIVE TREATMENT OF ANGINA PECTORIS

- Kohlerm, R, and vonder Weth, G Ztscher f Klin Med, Berlin 1923, vol xcix, pp 205-231
- Mortensen, M A Battle Creek Bull, vol xx, p 18
- Odermatt, W Deutsche Ztscher f Chir, Leipzig, 1923, vol clxxii, pp 341-354
- Pepper, O H P Prog Med, Phila, 1923, vol iii, p 168
- Pleth, V Amer Jour Surg, N Y, 1922, vol xxxvi, p 300
- Ransohoff, J L ANNALS OF SURGERY, 1925, vol lxxxi, p 585
- Reid, M R, and Friedlander, A Jour, A M A, 1924, vol lxxxiii, p 113
- Reid, M R, and Eckstein, G Jour A M A, 1924, vol lxxxii, pp 114-117
- Reid, M R, and Andrus, W de W ANNALS OF SURGERY, 1925, vol lxxxi, p 591
- Reid, W D Jour, A M A, vol lxxxiii, p 1528
- Stearling, A E Bull Med Jour, London, 1921, vol ii, p 95
- Seneque, F Presse Med, Paris, 1924, vol lxxii, p 171
- Wenchebeck, K F Brit Med Jour, 1924, vol i, pp 809-815



# ACUTE MASSIVE COLLAPSE OF THE LUNGS\*

A DISCUSSION OF ITS MECHANISM AND OF ITS RELATION  
TO FOREIGN BODIES IN THE BRONCHI AND POST-OPERATIVE COMPLICATIONS

BY CHEVALIER JACKSON, M D

AND

WALTER ESTELL LEE, M D

OF PHILADELPHIA, PA

THIS term, acute massive collapse of the lungs, was given by the English Pasteur in 1908,<sup>29</sup> to a condition which he found post-mortem in children dying suddenly with nasal and pharyngeal diphtheria. Since this original description the condition has been found associated with many other lesions and the propriety of the term, acute massive collapse, has been questioned. Collapse of the lung, as usually employed, infers such a deflation of the alveolar tissues and bronchi as results from the positive intrapleural pressure of pneumo-, hydro-, and pyo-thorax. In this phenomenon of acute massive collapse of the lungs there is a deflation of massive and partial areas of alveolar tissues, but probably no collapse of the bronchi. The term atelectasis, or collapse of the alveolar tissues of the lungs, describes more accurately this condition and we hope with Scott, Pancoast and other more recent contributors to the subject, that this term will eventually replace the original expression of Pasteur. However, in this report we will use the term collapse.

In 1910,<sup>17</sup> Pasteur stated that there was a close connection between the mechanism producing massive collapse of the lower lobes of the lungs, in what he thought was post-diphtheritic paralysis,<sup>5c</sup> and that underlying pulmonary collapse following operative procedures. In 1914 he records a group of 201 post-operative pulmonary complications in which he recognizes 16 cases of massive collapse, or a proportion of 8 per cent.<sup>18</sup> It is of definite significance that all of these cases of pulmonary collapse followed abdominal operations. Since this report 48 cases have been recorded in literature, and in January, 1925, Scott<sup>53</sup> had collected 64 cases. In addition to this group we have had access to the unpublished records of 9 cases. Five of these cases occurred in the service of one of the authors.

Pasteur would have us confine this term to a condition of massive collapse in which the alveolar portion of the lungs is completely deprived of air. When incompletely airless he suggests the term "partial deflation." This seems to us unnecessarily confusing. Undoubtedly varying degrees of pulmonary collapse occur, and Briscoe<sup>15</sup> states his belief that a large majority of post-operative pulmonary complications are entirely due to varying degrees of pulmonary collapse. To us its clinical importance as a post-operative complication lies, not in the occasional massive collapse that is encountered,

---

\* Read before the American Surgical Association, May 5, 1925

## MASSIVE COLLAPSE OF LUNG

but in the frequent partial collapse of varying degrees which occurs after certain types of operative procedures, trauma and other conditions of which we will speak later. Until the present time only massive collapse has been reported, but in the last six months we have been in more or less constant attendance at the post-mortem examinations at the Pennsylvania Hospital conducted by Dr J R Paul, where he has demonstrated beyond question that partial pulmonary collapse is a very common condition in the lungs after death and that its significance has been overlooked by pathologists in the past.

### *The Usual Phenomena*

*Physical Signs*—From a few hours to as long as seven days after a surgical operation, usually abdominal, the patient suddenly presents symptoms of a catastrophe. It is impossible at first to localize the trouble. The thorax after a short time will engage one's attention because of the cyanosis which usually appears almost with the onset. Acute dilatation of the heart, coronary embolism, pulmonary embolism or infarction are the

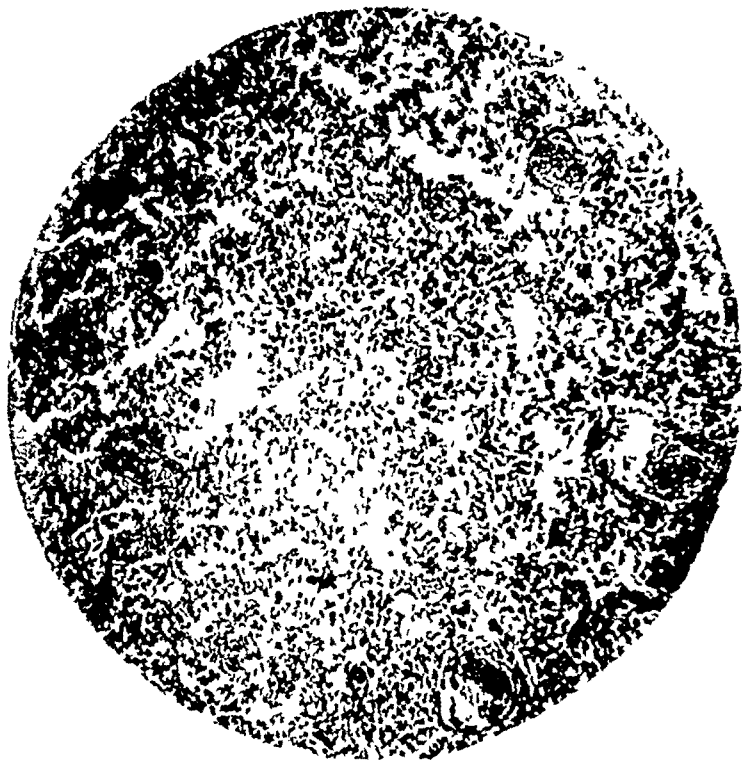


FIG 1—Patient Lee—Belk—Perkins, Bryn Mawr Hospital. Section taken from an area of massive pulmonary collapse of the lower lobe of the right lung. Collapse occurred three days after an operation for the relief of a strangulated left femoral hernia under local novocaine anesthesia. Death occurred on the eleventh day after onset of pulmonary collapse.

usual preliminary diagnoses. A more careful examination may suggest a pneumothorax. There may or may not be an increase in the respiratory rate sometimes reaching as high as 30 or 40. The pulse-rate and the respiratory rate, will, of course, be directly proportionate to the febrile reaction which in turn will be dependent upon the associated infections, as localized or generalized peritonitis. The physical signs in the chest are perhaps the most characteristic.

Upon inspection there are diminished or even absent respiratory movements of the chest wall over the affected area. The intercostal spaces apparently are hollow and very much narrower than upon the normal side. The cardiac impulse is seen displaced toward the affected side (just the opposite to that found in pneumothorax or pleural effusion). The apex of the heart has a tendency to tilt outward and upward, so that the apex impulse may often

be felt in the axilla (this is particularly true when it occurs on the left side) In two of our cases, right-sided, it reached the right anterior axillary line and was first diagnosed by the house officers as dextrocardia (a very common preliminary diagnosis) The dome of the diaphragm on the affected side is abnormally high and immobile The high diaphragm is readily detected by percussion in the left-sided cases On the right side, however, percussion is not so reliable, but X-ray examinations yield unequivocal evidence both as to its position and immobility



FIG. 2—Charles L. patient of Drs. Walter Estell Lee, Gabriel Tucker, Harry Wilmer and Howard Geissler, Germantown Hospital. Picture taken three days after the drainage of an appendiceal abscess by Doctor Davis and ten hours after the onset of the clinical symptoms of acute massive pulmonary collapse. Massive collapse of the middle and lower lobes of the right lung. Partial displacement of the heart to the right. Displacement of the trachea to the right. Radiograph by Dr. Henry T. Thissell.

tion and immobility

These findings are common to all cases, namely the physical signs which indicate a falling or pushing into the thoracic cavities of the surrounding structures, the mediastinum and diaphragm. Further analysis of the physical signs divide the cases into two distinct groups.

In both the dullness on percussion is present over the affected side and may extend as high as the clavicle, this is usually posterior, but it may be anterior. It corresponds to the area of the collapsed lung. The part of the chest cavity unoccupied by

the collapsed lung is hyperresonant and may be tympanitic. In one group the vocal fremitus is diminished or absent, while in the other it is increased over the dull area. In the group in which the vocal fremitus is diminished or absent the breath sounds are also diminished or absent, while in the second group the breath sounds are increased, tubular or amphoric in character and bronchophony and pectoriloquy are also extremely well marked.

This difference in the physical signs is probably dependent upon the patency of the bronchi. When there is a large proportion of air in them there

## MASSIVE COLLAPSE OF LUNG

is an increase in the breath sounds and they may be loud, tubular or amphoric in character and bronchophony and pectoriloquy may be present. One will readily see that the physical signs in the lungs are those commonly attributed to pneumonic consolidation, but if anything, the signs are even more marked, especially the tubular and amphoric character of the breath sounds.

Probably the reason massive collapse of the lungs is so frequently overlooked is that these physical signs of its presence are at once regarded as conclusive evidence —

of the existence of pneumonic consolidation. Due attention to the other signs, particularly cardiac displacement, should make the diagnosis clear.

In the type of cases in which there is dulness on percussion and diminished or absent breath sounds, the diagnosis is more difficult, unless adequate stress is laid upon the displacement of the cardiac impulse.

Broadly speaking, the type of case in which the bronchi are not patent is usually found in the early stage of the condition, while the patent bronchi are

found in the later stage of lung expansion. In two of our cases the sounds of the transmitted voice when heard through the stethoscope were almost deafening. Cardiac displacement is the most characteristic physical sign and the condition cannot be diagnosed with certainty unless this sign is present.

This marked displacement of the heart is rarely, if ever, accompanied by a cardiac murmur. Though the displacement is mainly lateral in cases where the whole lobe is involved, the displacement is also upward so that the maximum impulse may be felt in the third interspace or behind the fourth rib



FIG. 3 — Charles L., patient of Drs. Walter Estell Lee, Gabriel Tucker, Harry Wilmer and Howard Geissler, Germantown Hospital. Picture taken twenty-four hours after the onset of the clinical symptoms of acute massive pulmonary collapse. A slight increase in the amount of air in the right upper lobe since the taking of the last picture, but the heart has moved further to the right. Radiograph by Dr. Henry T. Thissell.

The X-ray corroborates all these physical signs and will be of the greatest aid when the lesion is on the right side

The lung shadow on the affected side will be more opaque and will suggest a purulent pleural effusion in its degree of density. The extent and density of this shadow will, of course, vary with the amount of lung involved and the degree of atelectasis. As the air returns this opacity gradually disappears,



FIG. 4.—Charles L. patient of Drs. Walter Estell Lee, Gabriel Tucker, Harry Wilmer and Howard Geissler, Germantown Hospital. Picture taken two days after the onset of the massive pulmonary collapse of the middle and lower lobes of the right lung and on the fifth post-operative day. This picture was taken immediately after bronchoscopic drainage of the obstructing mucus from the bronchi of the right middle and lower lobes. The middle lobe contains less air than the upper and lower lobes, both of which contain a larger amount than before the bronchoscopic drainage. The heart has also moved to the left and the level of the right diaphragm is almost normal. The trachea is in the midline. Radiograph by Dr. Henry T. Thissell.

or *more* lobes is the part most frequently affected. In the lobar type one or both lobes are usually affected. In the total variety the whole lung is in collapse.

Rose-Bradford<sup>19</sup> gave the first exhaustive discussion of this phenomenon which he encountered so frequently as a result of gunshot wounds of the chest. That it was not fully recognized by him until after very extensive experience with chest wounds probably means that it is much more frequent than he found. He reports his belief that it occurs in fully 10 per cent of all non-penetrating injuries of the thoracic wall. He did not have the opportunity

the opposite to a pleural effusion! Instead of an increased intrapleural pressure, as in pleural effusion, with a pushing away of the heart and diaphragm, there is a negative one and the heart and the diaphragm encroach or are pushed into the empty pleural space. The X-ray interpretation in one of our cases was subdiaphragmatic abscess.

*Varieties*—The clinical varieties of massive collapse are quite similar, irrespective of their etiology. Thus the clinical forms may be (1) lobular, (2) lobar, or (3) total in distribution. In the lobular or partial type the upper or middle third of one

of seeing patients who had wounds of other portions of the body, his work being confined to those of the chest, but as we have elsewhere stated he had knowledge of its occurrence following abdominal wounds, wounds of the pelvis, buttocks and lower extremities, but in no cases with wounds of the head or upper extremities

The varieties encountered in thoracic wounds he divided into homolateral, contralateral and bilateral, all of which may be lobular, lobar or total. The contralateral variety of massive collapse involving the whole of one lobe of one lung is a very remarkable condition, more especially as in many cases the wound on the opposite side is not only non-penetrating but most trivial in character, causing no fracture or extensive injury to the chest wall. Personal communications from a number of American, English and French medical officers in the last war has given evidence that this phenomenon was frequently recognized but unexplained. In the war, of course, the determination of its

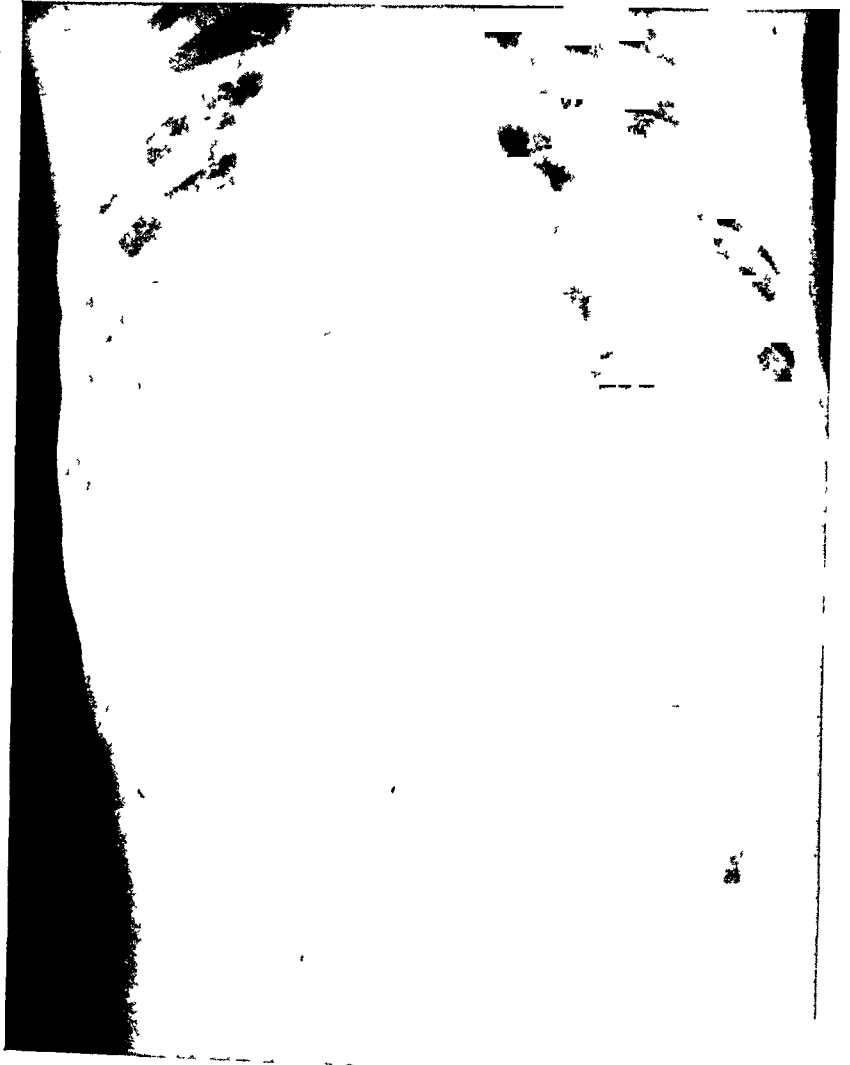


FIG 5—Charles L., patient of Drs Walter Estell Lee, Gabriel Tucker, Harry Wilmer and Howard Geissler, Germantown Hospital. Picture taken fifteen minutes after the taking of Fig 4. Radiograph by Dr Henry T. Thissell.

earliest establishment after the receipt of the wound was quite impossible but Rose-Bradford reports that he had a recent case which was completely established with total massive collapse of one lobe fourteen hours after the receipt of the injury.

*Incidence*—This phenomenon has been described as associated with many conditions since Pasteur's original report. Thus Norris and Landis speak of massive collapse of the lungs as a complication of pneumonia. Rose-Bradford<sup>10</sup> reports the autopsy of such a case. Tidy<sup>21</sup> reports an undoubted case of massive collapse of the entire right lung in a case of diaphragmatic pleurisy. Jorg,<sup>49</sup> in 1832, Legendre and Bailly,<sup>40</sup> in 1844, and Reynolds,<sup>22</sup> in

1871, described the airlessness in the lungs of newborn children and Reynolds called the condition apneumaptosis, or, as we now speak of it, atelectasis. He was convinced at this early date that the distribution of the affected lobules has a direct relation to the bronchial tubes, lobules supplied by one particular bronchial tube often presenting characteristic lesions, while lobules supplied by closely adjacent bronchial tubes were perfectly healthy. To his mind this precluded the possibility of an infection spreading by simple continuity. Literature contains the largest number of references to this phenomenon



FIG. 6.—Charles L. patient of Drs. Walter Estell Lee, Gabriel Fucker, Harry Wilmer and Howard Geissler, Germantown Hospital. Picture taken twenty-four hours after the bronchoscopic drainage of the obstructing mucus in the bronchi of the right middle and lower lobes and three days after the onset of the massive pulmonary collapse of these lobes. The reaccumulation of mucus again obstructs the bronchi and the collapse of these two lobes is almost as great as Fig. 1. Radiograph by Dr. Henry T. Thissell.

occurring after diphtheria, as originally described by Pasteur.<sup>1</sup> The military surgeons supply the next largest group in those following trauma, especially following unilateral wounds of the thoracic wall and occasionally wounds of the buttocks, pelvis and thigh. And, finally there is an increasing incidence in the surgical literature as its relation to operative procedures, especially upper abdominal, is becoming appreciated.

Thus this condition may develop as a congenital deformity (as in apneumaptosis in the newborn), it may develop spontaneously (as in diaphragmatic pleurisy), it may follow infection in the lungs or in the bronchi (as in pneumonia and purulent bronchitis), it may follow non-penetrating traumatism of the chest wall and of the adjacent abdominal wall, buttocks and pelvis. Chevalier Jackson<sup>20</sup> has demonstrated its occurrence in cases of foreign bodies in the bronchi, and it has probably a greater incidence after abdominal procedures than the 8 per cent reported by Pasteur. For such varied conditions it would seem difficult to find a common etiological factor and this is apparently true judging from the discussion of its etiology that appears in the recent literature.

*Etiology*.—Pasteur<sup>22</sup> in his study of post-diphtheritic phrenic paralysis quotes perhaps one of the earliest observations made by Martin and Hare, who found bilateral collapse of the lungs in animals dying after section of both phrenic nerves.

## MASSIVE COLLAPSE OF LUNG

Briscoe<sup>10</sup> experimenting with normal rabbits, divided the phrenic nerve on one side of the neck and was able to obtain varying degrees and locations of pulmonary collapse following this procedure. Curiously the deflation was not limited to the same side as the paralyzed half of the diaphragm. The opposite lung was affected in almost the same area, and frequently to a greater extent. He was also unable to obtain any evidence of reflex paralysis or arrest of one-half of the diaphragm as the result of intra-abdominal irritation. Of course, as he says, these experiments were tried on normal animals and not ill ones, as the patients of Pasteur. He reports three observations on cases of spinal paralysis due to injury and paresis, in which there was a complete paralysis of the cord high up, and in these cases he found complete deflation of the pulmonary lobes.

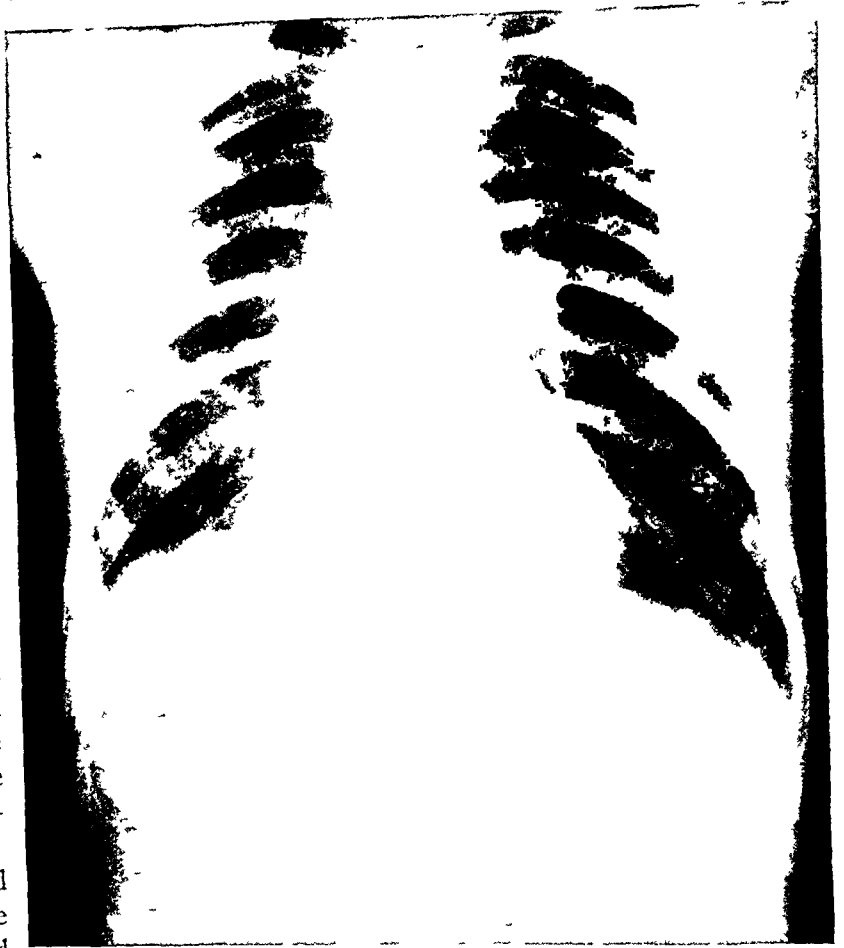


FIG. 7.—Charles L. patient of Drs. Walter Estell Lee, Gabriel Tucker, Harry Wilmer and Howard Geissler, Germantown Hospital. Picture taken two days after the first bronchoscopic drainage of the obstructing mucus and just before the second bronchoscopic drainage. This was three days after the onset of the symptoms of massive pulmonary collapse. In the preceding twenty-four hours there had been a copious expectoration of thick tenacious mucus similar to that removed through the bronchoscope. The air capacity of the lungs is now almost normal. The heart has returned to its normal position and the trachea is in the midline. Radiograph by Dr. Henry T. Thissell.

Schroeder and Green<sup>11</sup> state, as the result of clinical and experimental work with animals and birds, that the diaphragm is an essential muscle of respiration, that the nerve supply is practically

dependent upon the phrenic nerve, that after section of the phrenic nerve the intercostal nerve supply is not sufficient to carry on the action of the diaphragm, that section of one phrenic nerve produces collapse of the lower lobe of the lung on the effected side. This, of course, is not in agreement with the work of Briscoe. The destruction of one phrenic nerve in man is not necessarily fatal.

Pearson Irvine<sup>12</sup> reports a case of diphtheritic paralysis of the thoracic muscles with an overaction of the diaphragm. In this case there was a definite collapse of the upper lobe of the lung. He is perhaps the first to suggest that this collapse of the lung is not only due to lack of movement of the thoracic cage, but to some extent to paralysis of the bronchial tree.

Licthelm<sup>13</sup> produced a definite collapse in the lung tributary to bronchi in which he had placed laminaria plugs. These experiments were performed with rabbits. This theory of bronchial obstruction is one which has appealed to many men and which, as before stated, has been clinically demonstrated over and over again by Chevalier Jackson in his experience with foreign bodies in the bronchi.



Elliott and Dingley<sup>27</sup> suggest that in man, consequent to immobilization of the thoracic wall and diaphragm, irrespective of its cause, secretion collects in the bronchioles, and even in the larger bronchi, sufficient to prevent the egress of air, and leads to a gradual absorption of the alveolar air by the pulmonary circulation and ultimate col-

lapse and airlessness of the lung tissue. We have been able to confirm this by autopsies in two cases which are referred to elsewhere in this article.

Graley and Hewitt suggest the curious explanation that the tapering funnel-like character of the bronchial tree would necessarily have an action on the obstructing plugs similar to that of a ball valve, the effect of inspiration being to propel the plug towards the alveolar tract and to jam it when it arrives at a bronchial tube whose calibre is less than the one it originally occupied. During expiration it would be dislodged, allowing the air to escape from the alveoli. Rose-Bradford<sup>19</sup> is inclined to feel that obstruction does not play an important role. He emphasizes the fact that it is well known insufficient expansion of the chest, however pro-

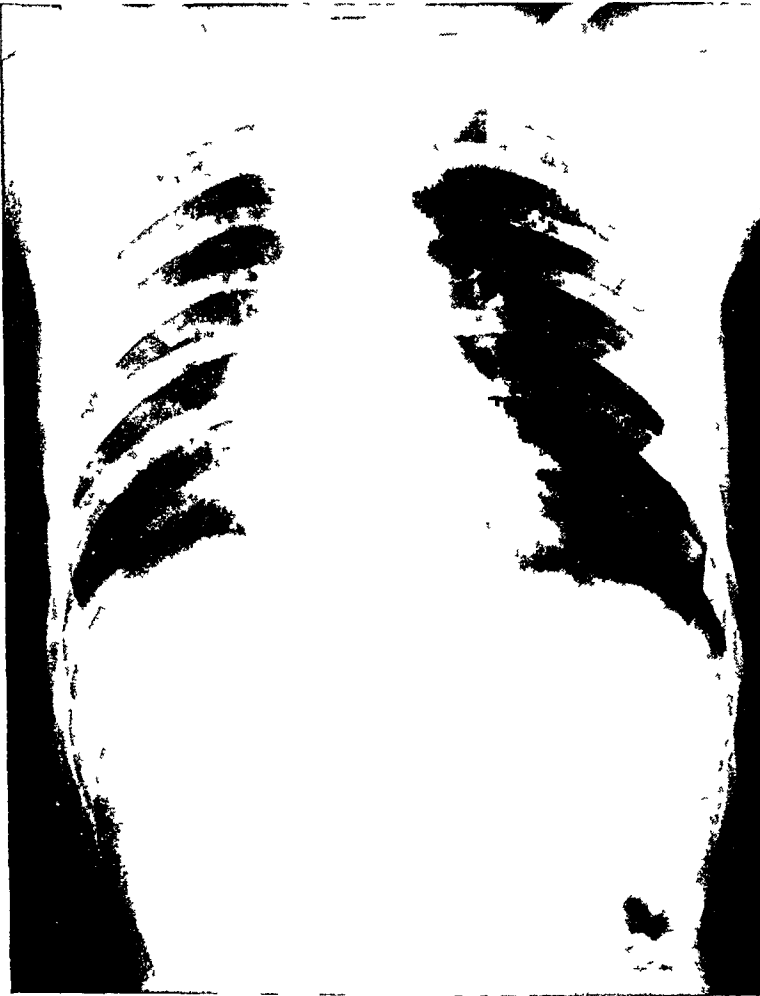


FIG. 8—Charles L. patient of Drs. Walter Estell Lee, Gabriel Tucker, Harry Wilmer and Howard Geissler, Germantown Hospital. Picture taken four days after the first bronchoscopic drainage of the obstructing mucus and it shows almost complete restoration to the normal. This examination was made immediately before the second bronchoscopic examination by Doctor Tucker. Radiograph by Dr. Henry T. Thissell.

duced, is capable of causing collapse of varying degrees of the underlying lungs. In some instances a constrained posture or a prolonged recumbence is sufficient to cause extensive collapse, involving, for instance, one lobe of the lung. This has been clinically confirmed and referred to by Willy Meyer.

Briscoe<sup>18</sup> agrees in part with this statement, and after his experimental work with animals and analytical studies of the effect of posture on the respiratory movements of various individuals, says that massive collapse of the lower lobe of the lung is a natural sequence of prolonged quiet breathing in the supine position in such people as do not use the abdominal muscles to fix the chest. He suggests that it is circulatory in its actual beginning, and that as a result of inhibition of the respiratory muscles an oedema develops, following which collapse takes place.

Rose-Bradford<sup>19</sup> also finds that in some unexplainable way this condition is brought about by reflex action, particularly when it follows injury on the opposite side of the chest, upper abdomen and lower extremities. He confesses that Briscoe was absolutely unable to demonstrate this experimentally. Cymbale<sup>28</sup> naively suggests that a man with a unilateral

chest wound would naturally lie upon the unwounded side, and the consequent immobilization of respiratory movement would be the real cause in the production of contralateral collapse

Jackson<sup>40</sup> reports from his clinic their experience with bronchoscopy in post-tracheotomic pneumonias, in which the surprisingly low mortality of 1 per cent is ascribed to their routine removal of obstructing bronchial secretions and diphtheritic membrane. He is convinced that the usual supposed pneumonia is an error of diagnosis. Over and over again they have seen the signs of pneumonia disappear in a few minutes after the removal of obstructing secretions from the bronchi. Many inspissated crusts of secretions were of sufficient size to obstruct completely a large bronchus. Jackson makes the definite statement that pneumonia is really one of the rarest complications following tracheotomy.

In this connection Jackson's recent experience with diphtheria in the Municipal Hospital in Philadelphia suggests that the post-diphtheritic collapse described by Pasteur, and believed by him to be caused by a paralysis of the respiratory muscles, is really due to bronchial obstruction of the passages by diphtheritic exudate. Certain it is that he and his assistants by the routine removal of these obstructing exudates in the bronchi have prevented this phenomenon of massive collapse in this clinic.



FIG 9.—Charles L., patient of Drs. Walter Estell Lee, Gabriel Tucker, Harry Wilmer and Howard Geissler, Germantown Hospital. Picture taken one hour after Fig. 7 and immediately after second bronchoscopic examination by Doctor Tucker. There is a complete restoration to the normal of the pulmonary tissues and the position of the heart. This is four days after the bronchoscopic drainage of right lung. Radiograph by Dr. Henry T. Thissell.

A careful analysis of these apparently diverse conditions with which massive pulmonary collapse has been found associated shows two factors to be practically constant. First, obstruction of the bronchial tree, which is followed by the absorption by the pulmonary circulation of the air imprisoned in the alveolar spaces distal to the obstruction.

Second, some interference with the respiratory movements. This interference may be partial or complete, but always results in decreased aeration of the pulmonary tissue on the involved side.

*Obstruction in the Bronchial Tree*—The effect of such obstruction was first demonstrated experimentally by Mendelsohn in 1845<sup>40</sup> and later by Liechtm in 1878,<sup>20</sup> but the clinical work of Chevalier Jackson and his assistants in the removal of foreign bodies impacted in the bronchi has established

this phenomenon beyond the possibility of controversy. Jackson states that this obstructive atelectasis has been shown by Manges at the bronchoscopic clinic to be a most valuable means of diagnosis of non-opaque bodies in the bronchi.<sup>54</sup> The similarity of the clinical symptoms and the X-ray pictures before and after the removal of foreign bodies through the bronchoscope to the findings in the massive collapse encountered in post-operative pulmonary complications has impressed us for some time. Jackson was the first to call attention to this and Leopold,<sup>44</sup> in his report speaks of Jackson's suggestion



FIG. 10.—I. P. patient of Dr. Charles F. Mitchell, Pennsylvania Hospital. Picture taken five days after the removal of a gangrenous appendix and drainage of an abscess by Doctor Robbins and six hours after the onset of the clinical symptoms of acute massive pulmonary collapse. Massive collapse of the middle and lower lobes of the right lung. Partial displacement of the heart to the right of the spine. Displacement of the trachea to the right. Radiograph by Dr. David R. Bowen.

pneumonia of the upper two lobes. In tracing the bronchus of the lower lobe definite plugs of organized or agglutinated purulent mucus were found in the bronchus, which completely blocked the pulmonary tissues served by it.

To quote the record of Doctor Belk: "The autopsy showed briefly in monolous right lung with only two lobes. The upper lobe was the seat of a lobar pneumonia. At its root of the lung was a definite abscess about 3 cm. in diameter filled with a heavy, sticky, purulent material. This abscess was in direct connection with the bronchus to the lower lobe which is completely occluded. This lobe was partially collapsed leaving a space about 8 x 8 x 12 cm. between itself and the upper lobe. Dense adhesions to the diaphragm had apparently prevented the lower part of the lobe from contracting upward. In addition to the collapse there were small areas of lobular consolidation present. Crepitation was barely appreciable. From a pathological standpoint the case is undoubtedly an example of partial pulmonary collapse resulting from occlusion of a bronchus. (See Fig. 1.)

that possibly a bronchoscopic examination might not only determine the etiology of this condition, but also serve as a therapeutic procedure. We have previously reported a case,<sup>43</sup> our first clinical observation of post-operative massive pulmonary collapse, which followed an operation under local novocaine anesthesia for a strangulated left femoral hernia. At autopsy Belk found a definite collapse of the lower right lobe of the lung with a purulent

## MASSIVE COLLAPSE OF LUNG

We again refer to this report because in a recent bronchoscopic examination made by Tucker similar plugs of mucus were found in the bronchi of a case in which acute massive collapse of the lung had occurred post-operatively. The removal of these plugs through the bronchoscope allowed the distal pulmonary tissue to re-expand with air as was shown by the X-ray taken by Doctor Thissell and the clinical examination made by Doctor Geissler and Doctor Wilmer. When the clinical and X-ray examinations showed a return to normal of the previously collapsed lung, a bronchoscopic examination demonstrated the disappearance of the mucous plugs that had been previously found.

Following are the notes of this case prepared by Doctor Stiles, resident surgeon of the German-town Hospital, in which this patient was operated upon.

"The patient, Charles L., a normal boy of twelve years. He was in the best of health until the time of the onset of his present illness. On January 6, 1925, he was seized with an attack of generalized abdominal pain, which

later settled in his right iliac fossa. Three days later the family physician called Doctor Wilmer in consultation, who sent him to the hospital. About an hour after admission to the surgical service of Doctor Lee, his abdomen was opened by Doctor Davis, with a muscle-splitting incision in the right iliac fossa, and this incision opened directly into a well walled-off collection of pus. The appendix could not be readily isolated, and a cigarette gauze drain was introduced into the wound. For 48 hours the patient was very comfortable, his temperature ranging around 99, his pulse around 100 and his respiration 28. Perhaps the most significant point in this portion of his history is that he was kept lying on his right side almost continuously in order to facilitate drainage.

About two o'clock in the morning of the third post-operative day the patient was awakened by a short but severe attack of coughing, after which he went back to sleep. At five o'clock his temperature had climbed to 101.3, his pulse to 120 and his respiration to 32. At 7.30 he complained that any effort to talk gave him great discomfort, and that he had a choking feeling in his throat. Physical examination at this time showed nothing



FIG. 11.—I. P., patient of Dr. Charles F. Mitchell, Pennsylvania Hospital. Picture taken four days after the onset of the clinical symptoms of massive pulmonary collapse. A small amount of air in the right upper lobe. Middle and lower lobes incomplete collapse. Heart displaced to the right of the spine. Trachea displaced to the right. Radiograph by Dr. David R. Bowen.

save distant breath sounds over the bases of both lungs posteriorly. There were no areas of dullness demonstrable. At noon the patient seemed more ill. His pulse had jumped to 140 and his respiration to 52. His temperature remained practically constant. He looked hard hit. His right chest scarcely seemed to expand with inspiration. On percussion impairment was found at the apex, dullness between the second and fourth ribs and a high tympanic note below the fourth rib. Posteriorly the percussion note was almost flat. The note over the entire left chest was distinctly hyperresonant. Breath sounds were tubular throughout the right lung. At the base the sounds were somewhat distant. The area of superficial cardiac dullness had moved markedly to the right. At the



FIG. 12.—I. P. patient of Dr. Charles F. Mitchell, Pennsylvania Hospital. Picture taken seven days after the onset of massive pulmonary collapse. Since previous picture (Fig. 11) there has been a slight increase in the amount of air in the right upper lobe; the heart has moved slightly to the left. The trachea is still displaced to the right and the intercostal spaces on the right side are narrower than on the left. Radiograph by Dr. David R. Bowen.

the level of the fifth rib it extended but 3 cm to the left of the midline and fully 6 cm to the right. The heart sounds were heard better over the right side of the chest than over the left. They were very distinct in the right axilla.

Doctor Lee saw the patient at the time and diagnosed the condition as one of pulmonary collapse, and ordered immediate X-ray examination (Fig. 2). The X-ray showed a collapse of the middle and lower lobes of the right lung with the heart displaced well over to the right.

The following day (fourth post-operative) the patient was much more comfortable. His temperature had fallen to 100, his pulse to 124, and his respiration to 36. He was coughing occasionally, bring-

ing up a thick grayish or greenish sputum. The right chest was retracted and almost motionless. The percussion note below the fourth rib was no longer tympanic but was flat. Distinct tubular breathing could be heard in this area. Posteriorly the breath sounds were tubular, but were not quite so distant. The X-ray showed the same picture as before. The second day after the onset of the collapse (and the fifth post-operative) the patient's condition was practically unchanged. He was still quite dyspnoeic. He could not say more than three or four consecutive words without having to catch his breath. Physical examination showed almost no change. The X-ray demonstrated somewhat more air in the lung than previously (Fig. 3). Late in the afternoon of the second day Doctor Tucker performed a bronchoscopy. He found marked inflammatory reaction in the bronchi of the right lung, which contained a tenacious mucus entirely closing up some of the air passages. As much as possible of this mucus was removed. Physical examination immediately afterwards showed a fairly resonant

## MASSIVE COLLAPSE OF LUNG

percussion note over the right chest above the fifth rib. Breath sounds seemed to be about normal save for some prolongation of expiration. Vocal resonance seemed practically normal. The area of superficial cardiac dullness had moved about 2 cm to the left, and an immediate X-ray examination showed much more air in the lung (Fig 4 and Fig 5). An hour and a half later the patient was sleeping quietly and his respiratory rate was 22. An hour after this, however, his respirations had increased to 30. The percussion note over his right chest anteriorly was again tympanic. On auscultation the breath sounds were much fainter.

The report of the bronchoscopic examination by Dr Gabriel Tucker and Doctors Clerf and Williams is as follows: "The larynx was only slightly inflamed. The tracheal mucosa was reddened and a thick, glary, grayish secretion was adherent to the tracheal walls. The inflammatory condition was more intense as the trachea was followed downward to the carina. The mucosa of the right bronchus was very red and inflamed. There was a ring of thick tenacious mucus completely surrounding the lumen of the right main bronchus. The left bronchus was only slightly inflamed and seemed to be entirely clear of secretion. The

thick secretion was removed by aspiration and the lower bronchial divisions in the right lung were explored. The mucosa in all the bronchi was very reddened and thickened, and covered with a thick, tenacious secretion. The orifice of the upper right lobe bronchus was not completely blocked, but patches of secretion were adherent to the walls surrounding it. Secretion was abundant in the middle lobe bronchus, but there seemed to be an airway. The lower lobe bronchus seemed completely filled with a tenacious exudate. The exudate was aspirated from the upper lobe, the middle lobe and the main division of the right lower lobe bronchus. A swab specimen of the secretion was taken for culture. Deviation of the right main bronchus towards the right was noticed, but there was no evidence of bronchial compression. There seemed marked restriction of the bronchial movements. The inspiratory lengthening and opening of the bronchus was very slight particularly in the lower and middle lobe bronchi.

*Bronchoscopic Diagnosis*—Diffuse bronchitis involving the right main bronchus and branches, most marked in the stem, lower lobe and middle lobe bronchi. Bronchial obstruction of the middle and lower lobes due to masses of thick, taut, adherent, tenacious



FIG 13.—I P, patient of Dr Charles F Mitchell Pennsylvania Hospital. Picture taken ten days after the onset of massive pulmonary collapse. A marked increase in the amount of air in the right upper and middle lobes. Displacement of the trachea and the heart to the right less marked than in previous picture, Fig 12. Radiograph by Dr David R. Bowen.

secretion. The culture obtained from these secretions showed staphylococcus aureus and pneumococci.

The following two days (seventh and eighth post-operative) showed a slow improvement. Resonance on percussion gradually extended down the anterior chest wall, the heart moved slowly over towards the left, and the breath sounds began to approach normal. X-ray examination showed an increase in the aeration of the lungs. During this period the patient brought up considerable quantities of grayish sputum similar to that removed through the bronchoscope. Rales were heard frequently over the right chest, especially over the lower lobe (Fig 6).

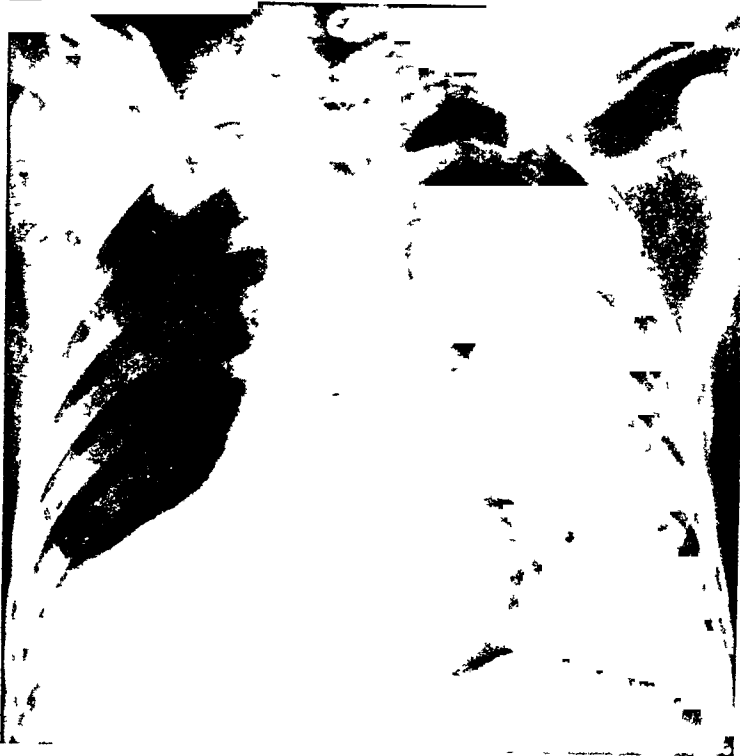


FIG 11.—I. P. patient of Dr Charles F. Mitchell, Pennsylvania Hospital. Picture taken thirteen days after the onset of massive pulmonary collapse. Upper and middle lobes reinflated with air to almost normal capacity. Lower lobe still in collapse. Trachea now in midline. No change of position of heart since last picture (Fig 13) which was taken on tenth day. Radiograph by Dr David R. Bowen.

The fourth day following the first bronchoscopy (the ninth post-operative) showed a marked improvement. The right chest seemed fuller. It was moving quite freely in respiration. There was resonance to percussion as far down as the sixth rib anteriorly. The area of superficial cardiac dullness extended twice as far on the left as on the right. Breath sounds were approximating the normal. The upper and middle lobes seemed to be functioning completely and the lower lobe partially. An X-ray examination at 3 P. M. showed much more air in the lungs than before (Fig 7).

At 3:40 the patient was again bronchoscoped (ninth post-operative day). The report of this examination, which was made by Doctor Tucker, assisted by Doctor Clerf, Dr Ernest Raffe and Dr Horace J. Williams is as follows:

The inflammatory condition of the tracheo-bronchial mucosa was less severe than at the previous bronchoscopy. A small amount of mucoid secretion, slightly purulent in character, was found in the trachea coming up from the right main bronchus. The mucosa of the left main bronchus was less inflamed, no secretion was present. The right bronchus showed marked deviation and the bronchial movements were much more nearly normal than at the last observation. On inspiration the bronchus seemed to lengthen and open about the normal excursion. Very little secretion was present in the upper right lobe bronchus. The middle lobe bronchus contained more secretion but was thin and quite easily aspirated. The lower lobe bronchus showed more marked inflammatory thickening, and the secretion was thicker and was aspirated with much more difficulty. Swab cultures were taken from the right main bronchus. All of the lower lobe bronchi were aspirated free of secretion. The culture from this swab showed staphylococcus aureus.

## MASSIVE COLLAPSE OF LUNG

Doctor Tucker summarizes his findings, and says that they indicate that there is a much greater degree of aeration in the right lower and middle lobes than at the time of the last bronchoscopy

Subsequent to this examination the physical findings showed practically a normal area of resonance over the right lung to percussion, both anteriorly and posteriorly. The heart seemed to be in normal position, the breath sounds were normal, save for some roughening. The vocal resonance seemed normal throughout. This was all confirmed by an X-ray picture taken immediately after bronchoscopy (Fig 8). The following morning the patient was very comfortable. Pulse, respiration and temperature were all normal. The right chest seemed to be moving practically as freely as the left. Percussion gave normal resonance throughout save for a slight impairment in the right lower lobe. Breath sounds were not quite so distinct over this area as over the rest of the lung. Vocal resonance was normal throughout. Many râles were heard over the lower lobe.

In contrast to this very prompt operative relief of the bronchial obstruction and the restoration of the alveolar tissue to the normal within 48 hours is the following history of a case where spontaneous relief was not complete until the lapse of over six weeks.

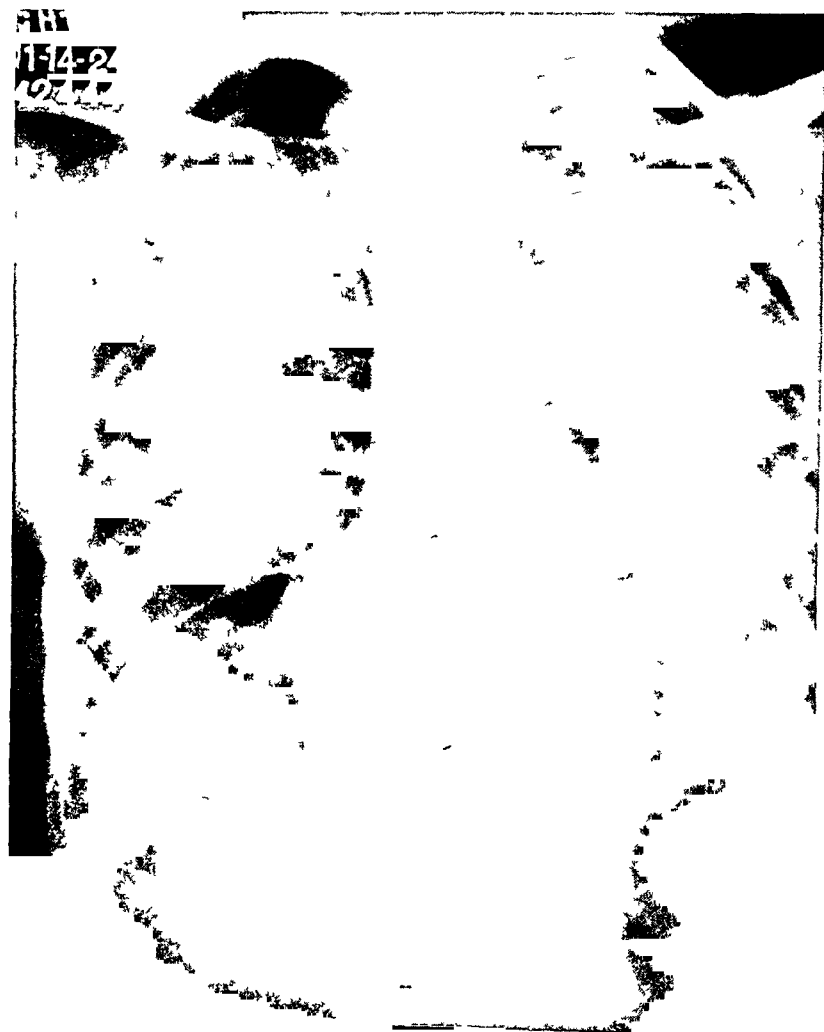


FIG 15—I T patient of Dr Charles F Mitchell Pennsylvania Hospital. Picture taken twenty-four days after the onset of massive pulmonary collapse. Upper and middle lobes are almost completely reinflated while the lower lobe is not entirely normal. The heart has moved further to the left but has not quite reached its normal position. Radiograph by Dr David R. Bowen.

A poorly nourished Jewish boy of fourteen years of age was admitted to the service of Doctor Mitchell at the Pennsylvania Hospital, October 16, 1924, with a diagnosis of appendiceal abscess with probable generalized peritonitis. He was operated upon by Doctor Robbins within one hour after his admission under nitrous oxide, oxygen anaesthesia. A gangrenous perforated appendix was removed and a localized abscess drained with one cigarette drain which reached into the pelvic cavity. He made a rather remarkable recovery from the operation until the fifth day, when at 6 A M he had a severe spell of coughing. As he had had a definite bronchitis before his operation and his lungs had been wet and there had been profuse thick greenish expectoration during these five days, no particular attention was paid to this at first. Following the spell of coughing his



temperature rose promptly to 105 degrees, his pulse to 152 and his respiration to 52. With the onset of the coughing there was definite cyanosis. He was seen by Doctor Lee four hours later, and a diagnosis of massive collapse of the lower lobe of the right lung was made.

Doctor Edgar's notes of a physical examination at this time were to the effect that the right side of the chest was sunken, the intercostal spaces retracted and there seemed to be no expansion on the right side of the chest. He complains of pain through the affected side. The heart is definitely moved over to the right side, and the right border is 5 cm to the right of the right edge of the sternum. There is a considerable area of dullness anteriorly and posteriorly which involves the upper and probably most of the middle

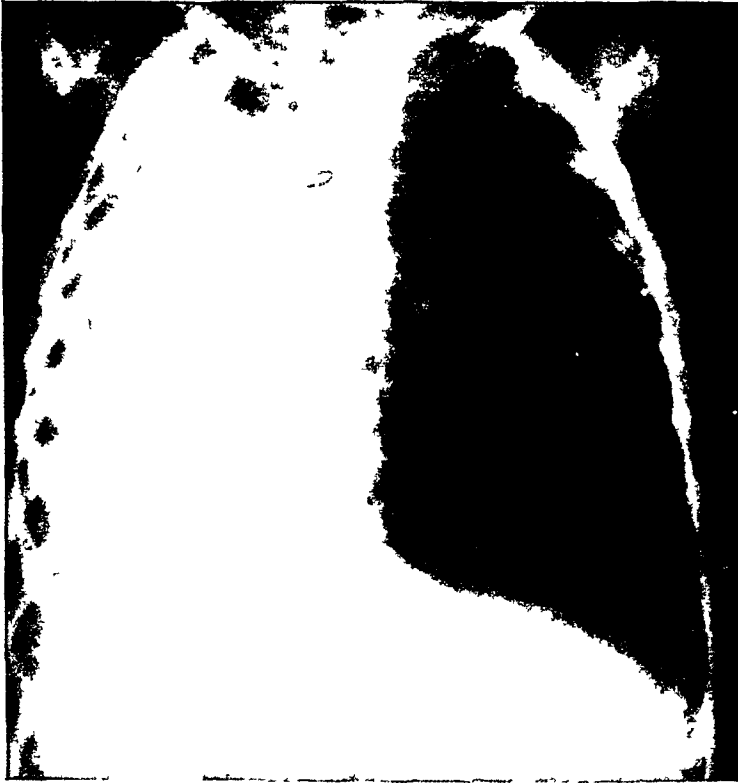


FIG. 16.—J. G. patient of Dr. Chevalier Jackson. Right main bronchus is obstructed by a bean. There is massive collapse of the upper, middle and lower lobes of the right lung. Complete displacement of the heart to the right of the spine.

lobe. Heavy percussion however gives a tympanic quality to this note. Local fremitus is increased over the right upper lobe, but it is absent over the lower right chest. The breath sounds are loud, amphoric over the entire right chest and diminish in intensity as one goes down towards the axilla and towards the posterior aspect. Voice sounds and whispering pectoriloquy are very pronounced and close to the ear. There are no crackling rales heard anywhere, although a few scattered bronchi or bronchial mucous rales are heard in both lungs. The precordial heave is pronounced over the lower right chest extending to the right nipple line. Sounds are loud, rapid but no murmurs are heard. Dr. Thomas McCracken saw the patient this day and concurred in these signs and with the diagnosis of massive collapse of the lung. Dr. Arthur Newlin also saw the patient at this time, and his notes include comments on the cyanosis of the lips and fingers with moderate dyspnea. He also notes the displacement of the heart: 'The whole right side is flat anteriorly. Breath sounds are faint below the third interspace anteriorly. The vocal resonance is increased and there is dry amphoric breathing.' The cough gradually became more productive and the expectoration of a thick green-yellow material which was noted before this. It is trophic has increased in quantity and freedom of expectoration. Almost daily X-ray pictures were taken which show the slow return of air to the collapsed portion of the middle and lower lobes and the gradual moving of the heart shadow to its normal position in the mediastinum and left thorax. On November 27, 1924 the X-ray shows that there is complete restoration to normal of the right lung and of the heart in its normal position in the thoracic cavity. A period of 42 days.

We have also had the unusual opportunity of observing an autopsy by Doctor Hoge

## MASSIVE COLLAPSE OF LUNG

at the Pennsylvania Hospital of an 18-year-old negress who died three days after a Cæsarean section performed by Doctor Piper at the Lying-in Hospital of Philadelphia. Three days after the Cæsarean section she developed an acute catastrophe which was first diagnosed as pneumonia in the left chest.

She was seen by Doctor Wolferth in consultation, and he noted a marked diminution of expansion all over the left lung. No marked alterations in percussion anteriorly and posteriorly appeared at the examination. Anteriorly and posteriorly there was typical bronchial breathing over both upper and lower lobes. On the right side the breathing is exaggerated and there are moist râles, particularly at the bases. The heart position is decidedly to the left, and apparently the mediastinal structures are deviated to the left.

"The last feature suggests the possibility of massive collapse of the lung, although at present the most likely diagnosis is post-operative pneumonia."

Doctor Wolferth did not feel certain of this diagnosis of massive collapse, and the patient died six hours after his examination.

An autopsy was performed at the Ayer Laboratory of the Pennsylvania Hospital before rigor mortis had set in.

*Anatomical Diagnosis Primary Fatal Lesion*—Post-operative collapse of the left lower lobe of the lung.

*Secondary or Terminal Lesions*—Recent pregnancy, recent operation, Cæsarean section, moderate localized peritonitis and paralytic ileus, complete atelectasis of the left lower lobe of the lung with purulent bronchitis and partial atelectasis of the base of the right lobe, mild bilateral hydro-ureter and hydronephrosis.

*Peritoneal Cavity*—The usual post-operative findings existed that one sees after an uncomplicated Cæsarean section. The uterine wound was healed, no leakage was present, and the incision was covered by a plastic exudate. The intestines were moderately distended. The liver appeared to be well above the costal margin. The right dome of the diaphragm occupied an unusually high position, reaching to the third rib, while the left dome is at the level of the fifth rib.

*Thoracic Cavity*—On opening the chest cavity one is immediately struck by the extremely limited size of the chest. A high position of the diaphragm (probably the result of the recent pregnancy) has reduced markedly the size of both cavities. The position of the heart when measured *in situ* shows the right side to be 5 cm. from the midline, and the left 8 cm. Both lungs appear small. There is no free fluid.



FIG. 17.—J. G. patient of Dr. Chevalier Jackson. Picture was taken of the same patient as in Fig. 16 but twenty-four hours after the removal through a bronchoscope of the obstructing bean from the right lung and the heart and trachea have returned to their normal positions.

*Heart*—The heart weighs 220 grams. It is normal in appearance and size, and the valves and chambers show no change.

*Lungs*—The lungs are removed with the trachea intact. Both upper lobes although small, appear moderately crepitant and air-containing. The lower lobes present an interesting picture. The right lobe is purplish in color with many dark patches. A close inspection reveals groups of pulmonary lobules which are definitely air-containing. The lower lobe on the left is extremely dark, quite limp and absolutely non-air-containing. The inferior edge all around presents a distinct lip of collapsed pulmonary tissue. On section of the left lung the lower lobe is found to be almost pitch black presenting the picture of complete atelectasis. Compression of this pulmonary tissue causes the exclusion of thick mucopurulent pus from the bronchioles. Dissection of the bronchial tree reveals extremely tenacious purulent mucous, filling the entire bronchi leading to the lower lobe. It is extremely sticky in character. On section of the lower lobe right side, the picture seen is that of a partial atelectasis. The presence of pus in the bronchioles is not demonstrable here. Both upper lobes although small appear essentially normal.

*Diaphragm*—The appearance of the diaphragm is interesting, especially on account of its relation to the pulmonary condition. There is a moderate injection of the vessels of the peritoneal surface particularly about the coronary ligaments. This same type of injection is present in the thoracic surface, especially on the left side. There is exudate on this surface.

*Microscopical Examination of the Lungs*—(Four sections in all) No. 2988, 1925. All show the same picture, varying in degree to some extent. There is diffuse atelectasis which is practically complete in all the sections studied, so that in many areas not the slightest vestige of an alveolar space remains, the tissues being composed of closely packed alveolar walls. One of the most noticeable features is the marked dilatation of the alveolar capillaries with all of the smaller vessels of the lungs appearing to be universally congested with distended red blood cells to several times their normal width. All of the bronchioles contain exudate, which is rich in fibrin, in the meshes of which are closely packed polymorphonuclear leucocytes and small mononuclear leucocytes, generally completely plugging the bronchiolar lumen. Interestingly enough the bronchial walls and the peribronchial spaces do not show evidences of surrounding infection comparable to the usual picture of bronchiolar pneumonia. Associated with the terminal bronchi however the evidence of infection and exudate definitely spread out through the strict and neighboring alveoli, causing small areas of bronchial pneumonia. *Diagnosis*—Bronchitis (Bronchiolar pneumonia with atelectasis of the lower lobes of both lungs).

*Complications*—If inflammation supervenes, râles may appear and a friction sound be heard over the accompanying pleuritis. Expectoration rarely appears until pneumonitis is established and it is seldom bloody until this stage is reached. Its presence is inferred largely by an increase in the severity of the symptoms rather than by any other sign. Purulent bronchitis undoubtedly occurs as a complication as is evidenced in our case. Pleurisy is not uncommon at a late complication. It is usually the dry variety giving rise to a friction rub but effusion may occur later.

*Differential Diagnosis*—The differential diagnosis must be made from acute dilatation of the heart, pulmonary embolus, pulmonary infarct, pleuritis, with or without effusion, pneumothorax and diaphragmatic hernia.

If one bears in mind that the affected side is retracted and immobile, that the diaphragmatic and cardiac encroachment on the affected side is extreme, that the general symptoms are invariably less severe than with pneumonia, embolism and infarction, that marked hyperresonance and increase of breath sounds with loud transmitted voice sounds are present the diagnosis should

be made. To this is added the high level of the diaphragm and the question of the displaced impulse. Pneumothorax is a very common mistaken diagnosis. Cardiac dilatation has been an explanation of the misplaced cardiac area. This is especially true when the collapse is of the left lung. The fact that even in cases of marked cardiac displacement the pulmonary physical signs may be comparatively slight, often gives rise to a mistaken diagnosis, such as dextrocardia, but after a lapse of a few hours or days there is usually a development of the pulmonary signs and the diagnosis is made conclusive by the return of the heart to its normal position.

The upward displacement of the diaphragm is a sign of the greatest importance and is detected on the left side by physical examination and on the right side by X-ray. It should also be remembered that when the entire lung and upper lobe or lobes are collapsed, the displacement of the cardiac impulse is oblique. In the first period the signs are those of retraction and immobility of the affected side, together with weakness or absence of breath sounds and displacement of the heart which is often extreme. In the second period weakness of the breath sounds has been replaced by loud tubular or amphoric breathing together with increased vocal fremitus, loud bronchophony, pectoriloquy and transmitted spoken voice. In the third period, the stage when the lung is expanding, abundant râles may be present over the area where the tubular breathing is marked. In both the second and third periods the heart is still displaced, but as we previously mentioned, the lung signs may sometimes persist over a small area at a time when the heart has returned to its normal position.

*Prognosis and Mortality*—It is impossible to estimate the mortality at the present time because of the general lack of recognition of the condition. We believe that we have had five cases during the last two years and have obtained an autopsy in two cases. Our purpose in presenting this subject before such a body is to obtain, if possible, the real incidence of post-operative massive pulmonary collapse. We are convinced that it is far greater than Pasteur's 8 per cent which he reported in 1914.<sup>16</sup>

To us this evidence, consisting of two post-mortem findings and one bronchoscopic examination *in vivo*, would seem conclusive evidence that obstruction of the bronchi by mucus plugs may produce varying degrees of pulmonary collapse, according to the character of the foreign body and the completeness of the obstruction of the bronchi produced by the mucus plugs. Manges, from his experience with foreign bodies, states that atelectasis or collapse does not occur until such times as the obstruction is complete to inspiration. If the obstruction is incomplete then instead of atelectasis you have the tissues beyond the obstruction overdistended with air. This may be the explanation of the two distinct clinical groups into which post-operative massive collapse may be divided. In one, over the area occupied by the collapsed lung, there is hyperresonance and even tympany, the vocal fremitus is increased and the breath sounds are loudly tubular or amphoric while bronchophony and pectoriloquy are well marked. Here we

may have incomplete obstruction to inspiration. The clinical symptoms in the second groups are exactly the opposite, vocal fremitus is diminished and the breath sounds are absent over this area and the atelectasis is complete as we would expect in a sudden and complete obstruction of the bronchi.

The other factor common to conditions in which acute massive collapse of the lung is associated is partial or complete arrest of the respiratory movements. Thus, in pleurisy, pneumonia, diphtheritic paralysis of the diaphragm, or the voluntary and reflex inhibition of the diaphragm and abdominal muscles in upper abdominal operations, this mechanism is obvious. Just as important and more constant is embarrassment of respiratory movements resulting from unnatural and prolonged rest after abdominal operations and other operative procedures and accidental injuries. Tidy explains the contralateral collapse associated with non-penetrating wounds of the opposite chest wall, which was found so frequently during the war by the patient lying upon the well side and thus immobilizing its respiratory movements.

Decreased aeration probably results in an increase in the bulk of the bronchial secretions because of decreased evaporation. These secretions gradually increase and accumulate in the large bronchi and when a point is reached where the tidal air is insufficient to maintain an airway, and the cough reflex fails to expel the mucus, the lumen will become completely obstructed. When this does result we have the mucus obstruction acting exactly as a foreign body. Jackson<sup>1-2</sup> in several recent contributions has called attention to the normal function of the cough reflex. As he expresses it "The cough reflex is the watch-dog of the lungs." In view of this function we ask you to consider the effect of posture, severe post-operative abdominal pain and the generous pre- and post-operative use of morphin upon the expulsive cough necessary to clear the bronchial tree of secretion.

All this was clearly suggested by Elliott and Dingley<sup>27</sup> in 1914. Our present contribution consists in (1) having found a post-mortem in two cases such collections of mucus in the bronchi as to cause complete obstruction, (2) in having seen such obstructing masses of mucus *in vivo*, and that one of us (Lucker) removed these mucous masses or plugs through a bronchoscope and proved that after such removal the lung returned to its normal condition, (3) in recalling the suggestion of Briscoe,<sup>15</sup> Elliott and Dingley<sup>27</sup> and Elwyn that embarrassment of respiratory movement of the chest walls or the diaphragm is a predisposing factor, not only in the formation of the mucous plugs in the bronchi, but in the inability to expel them, (4) submitting evidence that this has been entirely confirmed by our clinical experience, (5) in stating that this phenomenon has definite surgical significance. To us its importance as a post-operative complication lies not in the occasional massive collapse that is to be encountered, but in the probable partial collapse of varying degree occurring after operative procedures particularly in the upper abdomen, and traumatism of the trunk, (6) in suggesting that the arrest in these collapsed areas of the small emboli

which are usually scattered by the circulation after all operative procedures in which the blood-vessels are opened, as has been proven by Cutler,<sup>1-2-57</sup> is an explanation of the mechanism of post-operative pneumonia (Lee<sup>43</sup>) The clinical picture of the so-called cases of post-anæsthetic pneumonia is so unlike the true lobar and lobular pneumonias which are seen by the internist and physician that it is strange we have so complacently accepted this diagnosis up to the present time

CONCLUSIONS —Acute massive collapse or massive atelectasis is a phenomenon which has been recognized in association with varied conditions Although diverse they have two factors in common which we believe have some bearing upon the etiology of pulmonary collapse, namely, embarrassment or paralysis of the respiratory movement and obstruction of the bronchial tubes The interference with the respiratory movements may be as slight as that resulting from posture and may increase to that of the voluntary or reflex inhibition from post-operative pain of abdominal operations, or even reach the complete paralysis which occurs in diphtheria Obstruction has been found to be caused by foreign bodies, bronchial secretion or extra bronchial pressure as is produced by tumors

Massive collapse of the lungs is a comparatively rare condition and its incidence post-operatively is approximately greater than 8 per cent However, it has a definite surgical significance which should not be overlooked The most characteristic sign is displacement of the heart towards the collapsed lung

Partial collapse of the lung is probably a very frequent complication following abdominal and particularly upper abdominal, operative procedures The arrest, in these areas of partial collapse, of multiple emboli coming from the operative field is probably the mechanism and the lesion which so frequently occurs after operative procedures, and which is commonly called post-operative or post-anæsthetic pneumonia

When infection is added to these minute multiple infarctions in the collapsed areas a true bronchial pneumonia is established This we believe is rare compared to the frequency of partial collapse combined with minute pulmonary emboli and infarction

If two of the factors underlying pulmonary collapse, either massive or partial, are (1) inhibition or arrest of respiratory movements and (2) subsequent obstruction of the bronchi with accumulated bronchial secretion, there are definite indications for prophylaxis and treatment of this condition The minimizing of the trauma of all operative procedures, the conservative use of morphia and other inhibitors of the normal hecic or cough reflex, and the avoidance of fixed or unnatural positions post-operatively would seem rational procedures The choice of such anæsthetic agents as have the least irritating effect upon the bronchi and result in the minimum bronchial secretions, as local anæsthesia, gas oxygen anæsthesia and ethylene, are mandatory All these measures are prophylactic After the condition of massive collapse is estab-

lished the dangers are not in the lesion itself unless it be bilateral but in the complications which are apt to ensue as pneumonia in one of our cases empyema and lung abscess. The fact that of the recorded cases that have recovered spontaneously the average duration of the recovery has been about twenty-one days and that in the case here reported seventy-two hours after removal of the obstructing bronchial secretion the lung had been restored to its normal condition is at least suggestive.

*Pulmonary Collapse Due to Foreign Body in the Bronchi* by Dr. CHEVALIER JACKSON. Doctor Lee has shown, and with the aid of the bronchoscopist Dr. Gabriel Tucker, has proven, that in at least some cases of post-operative massive collapse the condition is one of obstructive atelectasis. Doctor Lee and other members of this Association have asked me to say a few words on this form of pulmonary collapse which we are using almost daily as a diagnostic sign of non-opaque foreign body or of plugs of secretion that are essentially foreign bodies. We have seen at the Bronchoscopic Clinic, hundreds of cases with atelectasis affecting one or more lobes and often an entire lung. These cases have nearly all been due to bronchial obstruction, but all bronchial obstructions do not produce atelectasis. Some of them produce exactly the opposite condition of emphysema.

We have three types of bronchial obstruction, namely 1. By-pass-valve obstruction 2. Check-valve obstruction 3. Stop-valve obstruction.

I venture to predict that if you were to have every etherized patient examined immediately after operation with the Rontgen-ray using the certain special technic that we use at the Clinic for this work you would find all three types of obstruction. The technic consists of exposing the film at the extreme end of expiration and at full inspiration. As shown by Manges the usual exposure at the command "Take a full breath and hold it" will be often misleading. At fluoroscopy the phenomena are still more marked to the trained eye of the rontgenologist. The corresponding physical signs may be elicited by the trained physical diagnostician provided his examinations are made with the phases of the respiratory cycle in mind. Doctor McCrac has many times made the diagnosis by signs alone prior to the ray examination. In the ordinary routine physical examination the phenomena will be entirely overlooked.

By-pass-valve obstruction is the type of partial obstruction that permits both ingress and egress of air past the obstruction.

Check-valve obstruction allows the air to pass in but not to emerge. This produces obstructive emphysema. Of this we have seen hundreds of cases. It was first observed in a case of peanut kernel in the main bronchus, by Iglauder. We have seen it in hundreds of cases not only of all kinds of nut kernels in which it is diagnostic but also in cases of swollen bronchial mucosa and in cases of plugs of tough secretion. My friend and pupil, the late Doctor Lynah saw it many times also in cases of plugs of diphtheritic membrane. The usual mechanism of check-valve obstruction is the normal

enlargement of the diameter of the bronchial lumen during inspiration which opens a space for passage of air around the obstructive mass, this space being promptly obliterated by the normal expiratory diminution of the bronchial diameter. The pathologic factor is supplied not only by the bulk of the plug of mucus or other foreign body, but by the swollen mucosa of the bronchial wall which makes a soft cushion-like valve seat. The reverse of this check-valve obstruction in which air can get out but not in, is rare, because the lumen of the bronchus diminishes during expiration. Check-valve obstruction is due not so often to movement of the foreign body as to the normal expansion and contraction of the bronchial wall with inspiration and expiration, respectively.

Stop-valve obstruction is the type in which air cannot get either in or out. The residual air is absorbed and the tributary lung deflates, in other words, it collapses, and we have atelectasis. It is due to the keen original observation of Pasteur that we have been made aware of this condition as a post-operative pulmonary collapse. We have seen the same state of massive collapse frequently from plugs of secretion which we have removed. In one case my associate, Dr. Louis H. Clerf, bronchoscopically removed seventeen plugs of tough secretion, during four days, in a child aged three years. Each of the seventeen times death was imminent from collapse of both lungs due to plugging of both main bronchi. Beans and grains of maize often cause atelectasis or massive collapse of one lung because both the foreign body and the mucosa swell. Nut kernels do not swell, but the mucosa does, and after a preliminary stage of obstructive atelectasis from check-valve obstruction, we have obstructive atelectasis, if the nut kernel be not removed.

In a number of cases the foreign body has shifted, causing an atelectasis in different lobes, not simultaneously, but in succession. It has been very interesting to have Doctor Manges tell us in a case of shifting foreign body "How the prune stone is causing obstructive atelectasis of the lower lobe," the next day, "Now it is causing obstructive atelectasis of the upper lobe." Later, "Now it is causing obstructive emphysema of the upper lobe with obstructive atelectasis of the middle lobe." My feeling is, therefore, that careful examination at full inspiration and full expiration, after every operation under ether, will show in a small percentage of cases, all three types of bronchial obstruction.

There is (Fatzinger) another point I should like to make, namely, that obstructive atelectasis due to complete obstruction of a bronchus does not immediately disappear after removal of the obstruction. In other words, a lung collapsed because of a plugged bronchus does not immediately expand after removal of the plug. Why, we do not know, but as evidence that it does not do so we have on file an abundance of graphic records in the form of roentgenograms taken before and after removal of a foreign body.

In conclusion a word as to the danger of bronchoscopy. Cough can be largely controlled but its effect on a fresh abdominal wound is to be considered by the surgeon in the particular case. In general it may be stated



that the danger of bronchoscopy depends on how it is done. Properly and skilfully executed, it is free from danger considered apart from the condition for which it is done. Bronchoscopy by an untrained man is likely to have a high mortality even in a relatively normal patient. Sixty years ago it was dangerous to open the abdomen, in the way it was done then. When every surgeon has a bronchoscopic assistant, it will be realized that bronchoscopy is as safe and as useful as cystoscopy.

# REFERENCES

- <sup>1</sup> Cutler. Surgical Clinic of North America, vol II, pp 935, 945, Aug., 1922
- Cutler and Hunt. Arch Intern Med, vol XXX, pp 449-481, April, 1922
- <sup>2</sup> Pepper. Med Clin North Amer., 1921, vol V, pp 737-749
- <sup>3</sup> McKesson. Amer Jour Surg, vol XXXII, p 16, 1918, Quar. Sup. Anesthesia
- <sup>4</sup> Norris. Ill. Med Jour, Oct, 1921
- <sup>5</sup> Chevers. Guy's Hospital Reports, 1876
- <sup>6</sup> Mandl. Deutsch Zeit f. Chir., July, 1921, p 67
- <sup>7</sup> Gottstein. Klin Arch f. klin Chir., vol LVII, p 409, 1898
- <sup>8</sup> Mikulicz. Zerhandl. d. deutsch. Gesellschr. f. Chir., vol XXX, p 560, 1901
- <sup>9</sup> Hienle. Zerhandl. d. deutsch. Gesellschr. f. Chir., vol XXX, p 560, 1901
- <sup>10</sup> Sauerbrook. Zeitr. d. klin. Chir., vol CXXII, p 234, 1921
- <sup>11</sup> Mandl. Wein. klin. Wöchschr., vol XXXIV, p 214, May 5, 1921
- <sup>12</sup> Pasteur. Amer. Jour. Med. Sciences, 1890
- <sup>13</sup> Bibergeil. Koertter's Clinic, Berlin, 1906
- <sup>14</sup> Rupp. Arch. f. klin. Chir., Berlin, Mar. 21, 1921, vol CXX p 672
- <sup>15</sup> Pasteur. British Jour. Surgery 1914, vol I, p 587
- <sup>16</sup> Pasteur. Middlesex Hospital Reports, 1910, Lancet 1080
- <sup>17</sup> Briscoe. Quarterly Jour. Med. vol XIV p 293 April 1920
- <sup>18</sup> Rose-Bridford. Oxford Loose Leaf System Med., vol II, pp 127-137
- Norris-Landis. Diseases of Chest, 1922, p 487
- <sup>19</sup> Tidy. Lancet, London, May 2, 1914, p 1245
- <sup>20</sup> Gravel and Hewitt. Reynolds System Med. 1871, p 865
- <sup>21</sup> Rose-Bridford. Quarterly Jour. Med. vol XII, 1918-19 p 127
- <sup>22</sup> Schroeder-Green. Amer. Jour. Med. Sc. New Series, 123, p 196
- Pearson-Irvine. Clin. Transact. Lon. vol IX, 1876
- <sup>23</sup> Liehlem. Arch. Exper. Path. u. Pharm. vol X p 54 1878-79
- Elliott-Dingley. Lancet London May, 1914 vol I p 1305
- <sup>24</sup> Cymbble. Brit. Jour. Surg., vol V, p 363 Jan., 1918
- <sup>25</sup> Pasteur. Bradshaw Lecture London 1908 Lancet vol II p 1351, 1908
- <sup>26</sup> Scrimger. Amer. Jour. Surg. vol XXXVI pp 53-60 April, 1922
- <sup>27</sup> Herb. J. A. M. A., vol XXXIX pp 330-342 July 29, 1922
- Hirschbroeck. Amer. Jour. Med. Sc., vol CLIV, pp 268-274 Aug., 1922
- <sup>28</sup> Scrimger. Surg. Gyn. and Obst. 32 486 June 1921
- <sup>29</sup> Schlotz. Med. Jour. of South Africa, Jan. 1921 vol XVI, p 202
- Mortimer. Medical Press and Circular, vol CXXIII, 1919 pp 507-509
- St. John
- Hampton and Wharton. Johns Hop. Med. Bull. Apr., 1920, vol XXXI, p 95
- <sup>30</sup> Hall. Lancet, London Jan. 15 1922
- <sup>31</sup> Barling and Levestre. Manual of War Surgery p 191 Oxford Univ. Press
- <sup>32</sup> Elwyn-Girdman. J. A. M. A. Aug. 27 1922 No. 9, vol XXXIX p 718
- <sup>33</sup> Elwyn. J. A. M. A. Dec. 23 1922, vol XXXIX, p 2154

- <sup>42</sup> Elwyn J A M A , Feb 2, 1924, vol lxxxi, p 384
- <sup>43</sup> Lee ANNALS OF SURGERY, Apr , 1924, p 506
- <sup>44</sup> Leopold Amer Jour Med Sc , Mar , 1924, No 3, vol clvii, p 421
- <sup>45</sup> Whipple Surg , Gyn and Obst , vol xvi, p 29, Jan , 1918
- <sup>46</sup> Schlotz Med Jour South Africa, vol xvi, p 202, June, 1921
- <sup>47</sup> Gwyn Trans Amer Asso Phys , vol lxxviii, p 411, 1923
- <sup>48</sup> Ritvo Amer Jour Roent , vol xi, p 337, April, 1924
- <sup>49</sup> Lord Diseases of the Bronchi, Lea and Febiger, Phila , 1915
- <sup>50</sup> Jackson Amer Jour Roent , Jan , 1924
- <sup>51</sup> Jackson Therapeutic Gaz Sept 15, 1920
- <sup>52</sup> Phillips and Lafferty South Med Jour , 1923, vol xvi, p 685
- <sup>53</sup> Scott Arch of Surgery, Jan , 1925
- <sup>54</sup> Manges Amer Jour Roent , vol ii, p 517, Jan , 1924
- <sup>55</sup> Clerf Surg , Gyn and Obst , April, 1924, pp 472-474
- <sup>56</sup> Jackson Surg , Gyn and Obst , Apr , 1924, pp 472-474
- <sup>57</sup> Cutler and Hunt Arch Surg , vol i, p 114, July, 1920
- <sup>58</sup> Heuer Surg of Thorax, Keen's Surg , vol viii, p 351, 1921
- <sup>59</sup> Riesman J A M A , vol lxxxi, p 1256, Apr 19, 1924
- <sup>60</sup> Willy Meyer N Y Med Journ and Record, 1924 vol cxix, p 590
- <sup>61</sup> Jackson J A M A , 1922, vol lxxiv, p 1399

# EXTRACTION THROUGH THE THORAX OF PROJECTILES LONG RESIDENT IN THE LUNG<sup>1</sup>

By J. J. BUCHANAN, M.D.  
OF PITTSBURGH, PA.

VERY early in the recent great war, the French army surgeons were confronted with patients carrying projectiles in their lungs whose wounds had healed but who still had symptoms of greater or less severity—occasional

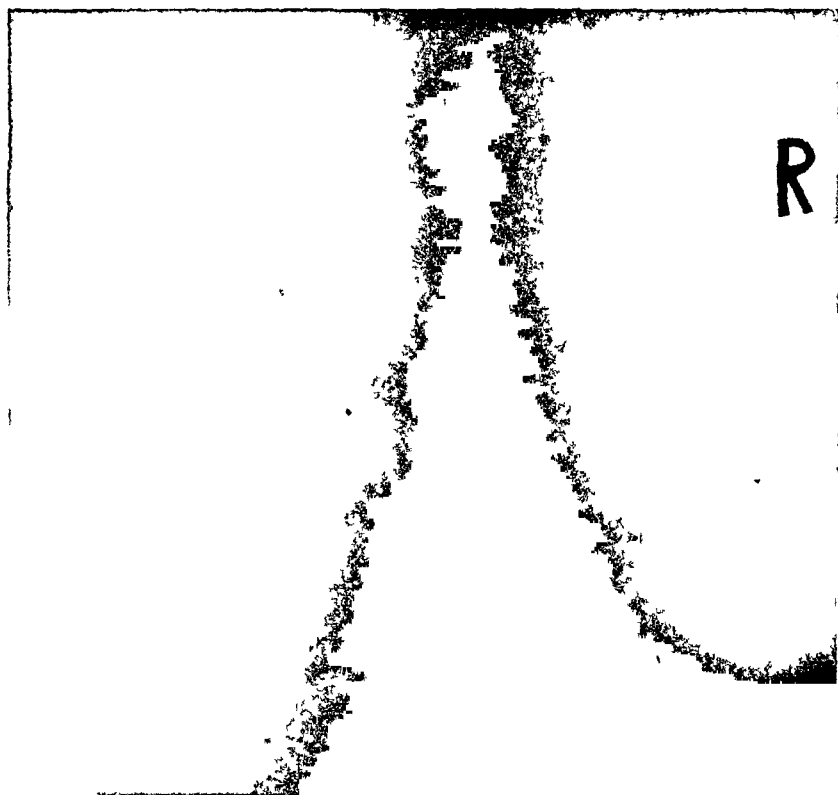


FIG. 1.—X-ray film made by Dr. Maurice Goldsmith of Pittsburgh before patient's admission to Mercy Hospital.

hemoptyses, purulent expectoration, dyspnoea on exertion and chest pains. The question of removing these projectiles to restore these soldiers to health and return them to duty became very acute. The credit of performing the first operation of this kind is due to Dr. Paul Maclaure,

who extracted a shell fragment three months after the war began (October 30, 1914) from the lung of a man who had been wounded six weeks before. Doctor Maclaure operated by a combined method of small thoracotomy and extraction with the forceps by the intermittent use of the fluorescent screen. Success with this method not only in the hands of its originator but also with many other surgeons, was remarkable.

Three weeks later the second extraction was made by Dr. G. Marion<sup>2</sup> by quite a different procedure. His method well adapted to the general

<sup>1</sup> Read before the American Surgical Association, May 5, 1925.

<sup>2</sup> Bull. et Mem. Soc. de Chir. de Par., 1914, vol. xl, p. 1350 and vol. xli, p. 14.

<sup>3</sup> *Ibid.* 1915, vol. xli, p. 1781.

## EXTRACTION OF PROJECTILES IN THE LUNG

run of surgeons, consists of localization with the X-ray, fairly liberal rib resection, if necessary, at the place most accessible to the projectile, firm anchoring of the underlying lung to the parietal pleura, incision of the parietal pleura in the centre of the anchored surface, incision of the lung to a depth sufficient to reach the projectile, palpation with the finger and removal with the forceps. It will be noted that the operation is done after localization of the projectile with the X-ray, by means of Marion's compass and no use is made of the fluorescent screen.

I am indebted to Doctor Marion for a personal letter dated March 3, 1925, in which he says, "I have operated 153 patients carrying projectiles in their lungs. All have been operated by my method.

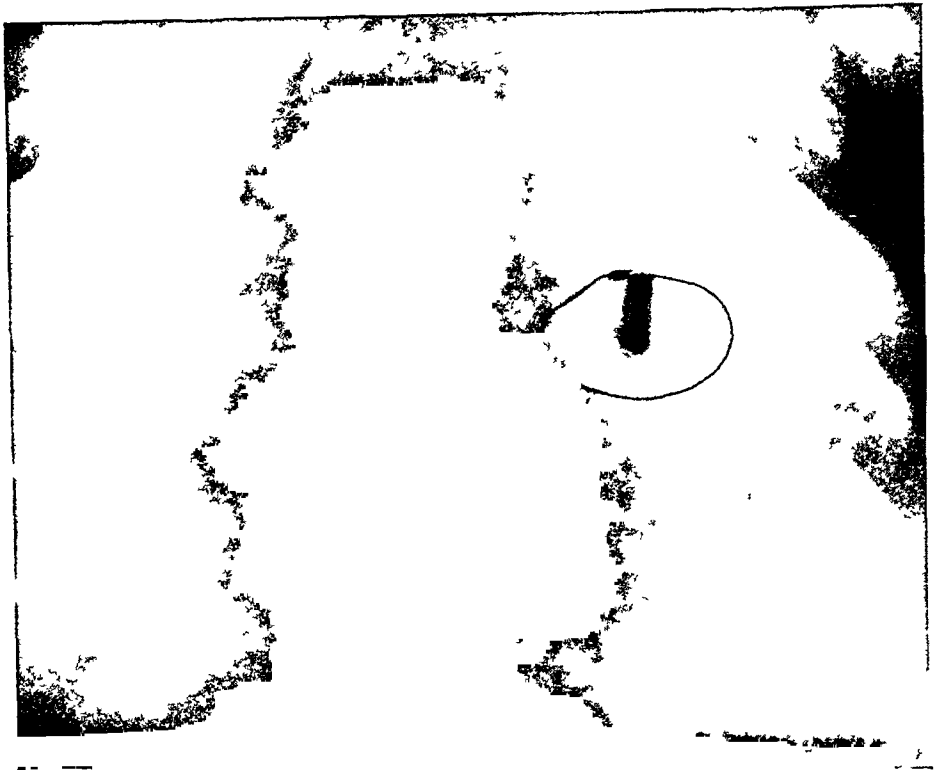


FIG. 2—X-ray film made at laboratory of Mercy Hospital with wire marker for localization two days before rib resection.

Mortality, 4 cases, (One on the table during removal of a projectile from the hilum, the extraction of the projectile opening a vessel of the lung against which it had been pressing, a second from embolism on the tenth day, two others from purulent pleurisy.)" Marion has had many followers who have reported equally good results in a smaller number of cases.

In 1915, Dr. Pierre Duval advocated and practiced the wide opening of the pleural sac, always by the technic of Willy Meyer, causing collapse of the lung by gradual pneumothorax, display of the part of the lung containing the projectile, removal of the projectile, suture of the lung wound, closure of the thorax without drainage and aspiration of the residual air.

Through the kindness of Dr. Pierre Duval, who has sent me a personal letter dated March 5, 1925, I am able to give his own results up to this time. "(1) I have operated on about 40 cases not published. My total number of old projectiles taken from the lung is therefore, about 80, with one death from double broncho-pneumonia. (2) I have always operated according to my own method. (3) Immediate results very good—one death in about 80 cases. Late results very good. I have followed the patients for many

months, and found good functional results and by radiograph a disappearance of the pachypleuritis in the majority of cases." The mortality in this brilliant, radical and highly scientific and surgical method, in the hands of its originator is thus seen to be only  $1\frac{1}{4}$  per cent, a result which has been approximated by other surgeons in France with fewer cases.

The procedure which has had the greatest vogue in France is that of Dr Petit de la Villeon who developed the method, which he termed "the buttonhole" operation, while acting as Naval Surgeon at the port of Brest.



FIG. 3.—X ray film with wire marker lateral view made at Mercy Hospital two days before rib resection

This method was admirably described and warmly commended by the late Dr Robert G. LeConte in a paper read before this Association six years ago. Doctor LeConte was an eye witness and careful observer of the extractions made at Brest by this method.

The first of these extractions was made on October 27, 1915,<sup>4</sup> almost a year after Maclaure's first operation.

Experiments on cadavers and animals had previously been made by Petit de la Villeon to show that a blunt forceps pushed through the parietal pleura against the lung would first dimple the surface and, by firm pressure, be made to traverse the lung pushing aside blood-vessels and air tubes in its course. Experience in the removal of thousands of projectiles from other parts of the body by screen extraction with forceps through a button-hole incision in the skin had made the surgeons at Brest proficient in this work and had emboldened Petit de la Villeon to try it on the lung.

The forceps extraction under the fluorescent screen by this method is prohibited by Dr Petit de la Villeon for projectiles located at the root of the lung and in the region of the hilum.

<sup>4</sup>Bull Acad de Med. Par. 1916 (meeting of March 7th)

## EXTRACTION OF PROJECTILES IN THE LUNG

The rapidity with which projectiles in all other parts of the lung are removed by this procedure, in the hands of its originator and his followers, is remarkable—thirty seconds, even twenty seconds, one minute, two minutes the usual length of time. It should be remembered, however, that this is the time required by experts, and means the time actually used in the extraction itself.

This method has had its opponents who have characterized it as blind, brutal, unsurgical.

Doctor Le Conte said "Three things are essential for the successful practice of the method (1) The radio-scopie eye must be acquired (2) The correlation of the two shadows made by the foreign body and the point of the forceps. This must be intuitive, with-



FIG 4—X-ray film, made for Dr Chevalier Jackson after insufflation of bismuth subcarbonate into left bronchus showing relation of bullet to bronchial tree

out process of thought, as a dentist works by a mirror or direct sight (3) Gentleness and dexterity of the hand. This is acquired by the removal of projectiles from less dangerous zones, as in the extremities."

Dr Rene LeFort, of Lille, France, who has done remarkable work in removing lung projectiles by many methods, including his own, said at the New York Academy of Medicine in 1919 "This procedure (Petit de la Villeon's) has been severely criticized. The tearing out in the dark of an invisible projectile, surrounded by unseen blood-vessels and tissue layers, is revolting to the surgical mind. The procedure is difficult and, even after some practice, often requires prolonged groping. The projectile escapes from the forceps and is pushed back into the dark recesses of the thorax where the

presence of opaque bloody extravasates further diminishes visibility and interferes with the exploration. The results are excellent, however, and the immediate and permanent sequelæ are extraordinarily free from complication. After lengthy explorations with the forceps in the midst of the lung tissue the patients may be seen walking about without disturbance or reaction of any kind 48 hours after operation. Such is the opinion of a Master of Lung

Surgery.  
Now, what are the tabulated results?

By the kindness of Dr. Petit de la Villcon, who has written me under date of March 17, 1925, I may quote as follows: "By my method more than 1000 intra-pulmonary projectiles have been extracted by myself and my friends with a mor-

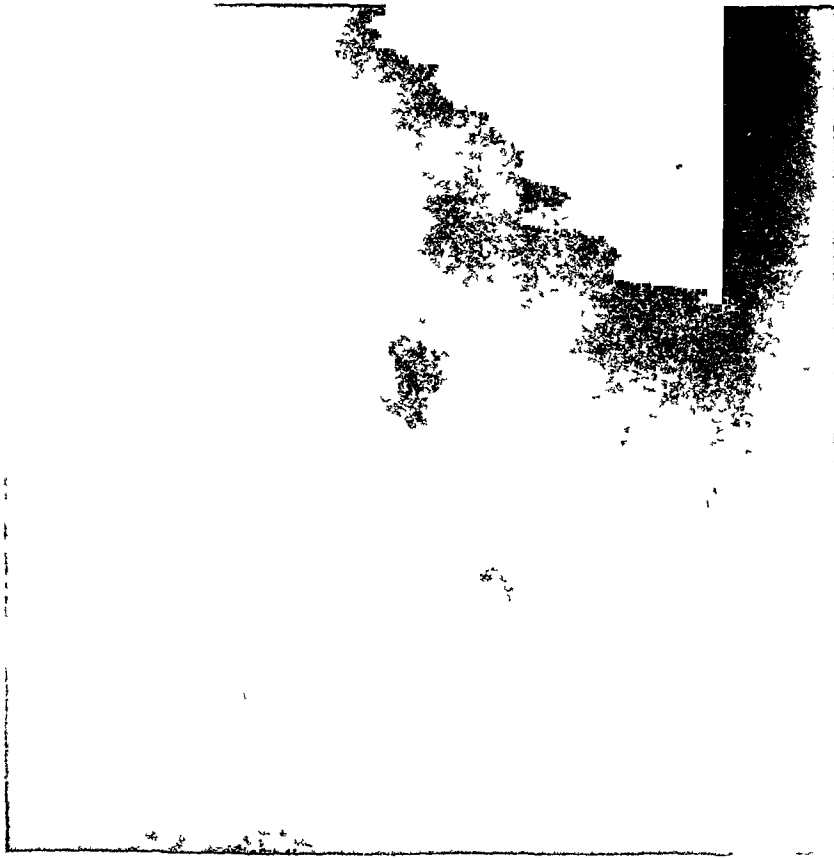


FIG. 5.—X-ray film (lateral view) showing relation of bullet to bronchial tree made for Dr. Chevalier Jackson after insufflation of bismuth subcarbonate.

tality of 5 patients ( $1\frac{1}{2}$  of 1 per cent). The method is classic to-day in France. It is adopted by the great majority of surgeons for its certainty, its safety, its simplicity, which made its success.

With reference to the subject of hilar projectiles, I must say that I am a partisan of the operation in two stages. The first stage has for its purpose the posterior thoracotomy and the production of pleural adhesions. The second stage (eight days later) consists of radio-operative removal of the projectile fixed in the lung and adherent. Then termination of the operation by tamponment without total pneumothorax.

Doctor Allain, who assisted Dr. Petit de la Villcon in all of his early extractions, who made this the subject of his graduation thesis, and who is now

\* Allain (J. E. A.) L'extraction des projectiles intra-pulmonaires par la Méthode Petit de la Villcon. historique et description. Paris, 1922.

## EXTRACTION OF PROJECTILES IN THE LUNG

Dr Petit de la Villéon's assistant in his surgical practice, says, "Providing against the remote possibility of a hemorrhage, Dr Petit de la Villeon has always ready at hand on his instrument table the material necessary for a rapid and urgent thoracotomy to control hemorrhage in the usual surgical way. But we must say that he has never had need to use these instruments."

The patient who brought this matter acutely to my own attention was referred to me by Dr J Giekin, of Pittsburgh, and gave the following

CASE HISTORY—Male, Hebrew, teacher, aged twenty-nine. Shot in Russia in March, 1920,

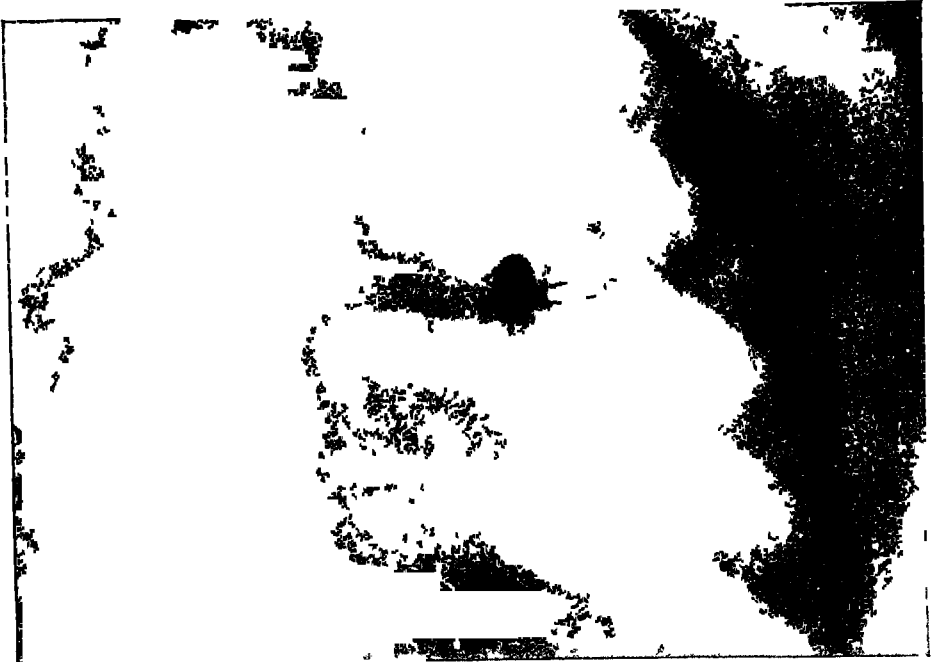


FIG 6—X-ray film after rib resection with safety pin as a marker, lying in the bed of the rib where resected

by one of Denikin's soldiers. Ball entered the left chest in front at the second interspace about two inches from the midline of the sternum. He spat some blood at once, but his wound healed in about three weeks and he was perfectly well during the following year. He then expectorated blood for three days, which he attributed to his having done heavy work. For more than two years thereafter he was perfectly well, not doing laboring work. Ten weeks before admission, however, he

again began to cough and spit up some blood followed by yellow sputum. He states that in this last period he would spit up about a wine-glass of blood at a time.

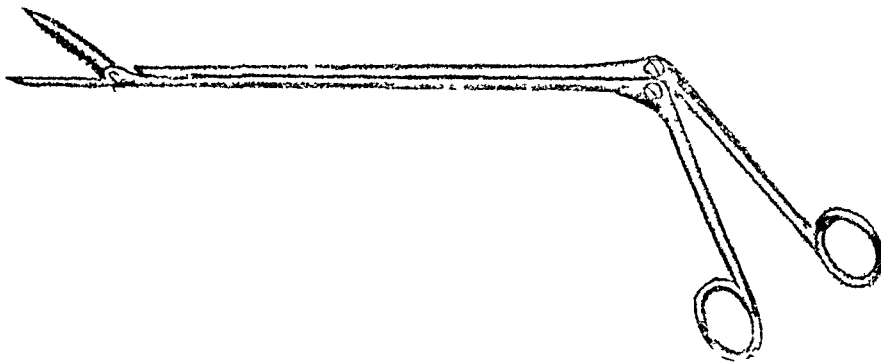


FIG 7—Petit de la Villéon's extraction forceps. Bull et Mem de la Soc de Chir de Paris 1916 vol xlii p 1890

Patient is a man with unusually massive chest and of healthy appearance. He has no physical signs of respiratory trouble. Fluoroscopic examination and X-ray films show an oblong bullet lying under the third rib and second interspace about an inch and a half from the left border of the sternum and at a depth of about three inches ( $7\frac{1}{2}$  cm) from the anterior chest wall. Examination of the films shows the shadow of the ball to be projected against the sixth rib posteriorly and between the inner border of the scapula and the spine which is within the trapezium



called the danger zone by Dr Petit de la Villon. The lateral view, however, shows the ball decidedly nearer the anterior than the posterior chest wall.

Dr Chevalier Jackson saw this patient at my request, and expressed the opinion that "the removal of the bullet by bronchoscopy would be a dangerous procedure because of the localization of the bullet so close to the root of the lung and so near the very large vessels." I am further obliged to Doctor Jackson for two localization prints made from X-ray films of this patient's chest after insufflation of his bronchi with bismuth. Inspection of the reproductions of these films shows the ball to be in the same relative position to the bony structures as appears on our films but gives us

additional knowledge of its relations to the bronchial tree.

#### Operation—

October 22 1923  
Ether anesthesia  
Resection of  $2\frac{1}{2}$  inches of third rib overlying the bullet. Most striking was the tumultuous action of the underlying lung. The wound was packed openly and the patient returned to his bed.

The next day, after cocaine anesthesia of the bed of the rib where resected, four catgut sutures were inserted one at each end and one

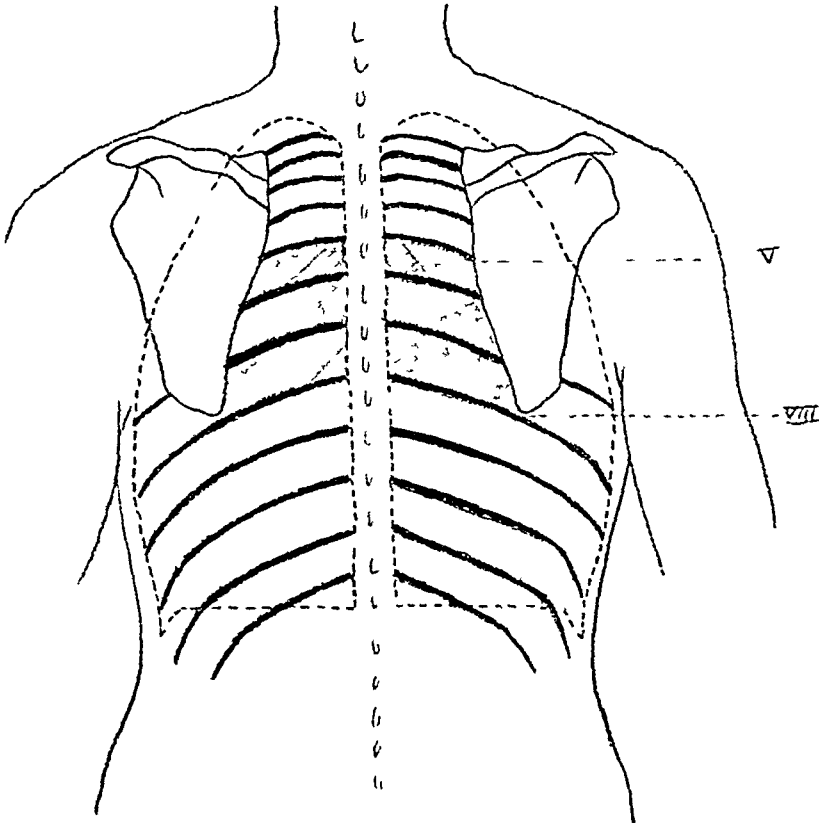


FIG. 8—Petit de la Villon's diagram of the danger zone for the Hilary region. Bull. et Mem. de la Soc. de Chir. de Paris 1918 vol. xlv p. 980.

at each side which took a good bite into the lung. An incision was made into the lung tissue which caused about as much bleeding as would follow a similar incision into the liver. A needle was passed about  $2\frac{1}{2}$  inches into the lung and contact was made with the bullet. A small amount of air was aspirated into the pleural sac, an irritative cough occurred, and the patient coughed up two or three teaspoonfuls of blood. Aspiration of air was easily stopped by light packing of the external wound.

Completion of the operation was deferred for two days. No anesthesia was required at this third sitting. Adhesion of the pleural layers by this time was complete. Contact with the ball was again made with a needle and the trick of the needle enlarged with a bistoury. The finger was then passed to the projectile and acted as a guide to a bullet forceps by which the bullet was removed.

The incision of the lung, the passage of the finger and the hitting of the projectile from its bed was followed by rather profuse bleeding, but the field was kept entirely free of blood by a suction apparatus such as is used in tonsillectomies. Very soon after the extraction the hemorrhage ceased. The external wound was lightly packed with iodoform gauze, no sutures being used.

## EXTRACTION OF PROJECTILES IN THE LUNG

*Convalescence* was uneventful. The patient left the hospital in fifteen days and has since remained well. This is the operation of Marion, of Paris, except for the fact that the operation was done at three sittings. In only seven of his cases did Marion postpone the completion of his operation till another day.

Late extraction of projectiles from the lung, according to available literature, seems to be an operation almost without vogue in this country. With the exception of

Dr Chevalier Jackson's two cases, one removed through the bronchoscopic tube<sup>6</sup>, the other by forceps extraction under the fluorescent screen,<sup>7</sup> I have been unable to find any recorded cases. The significance of this must be that bullets, which are practically the only projectiles here that lodge in the lung, give

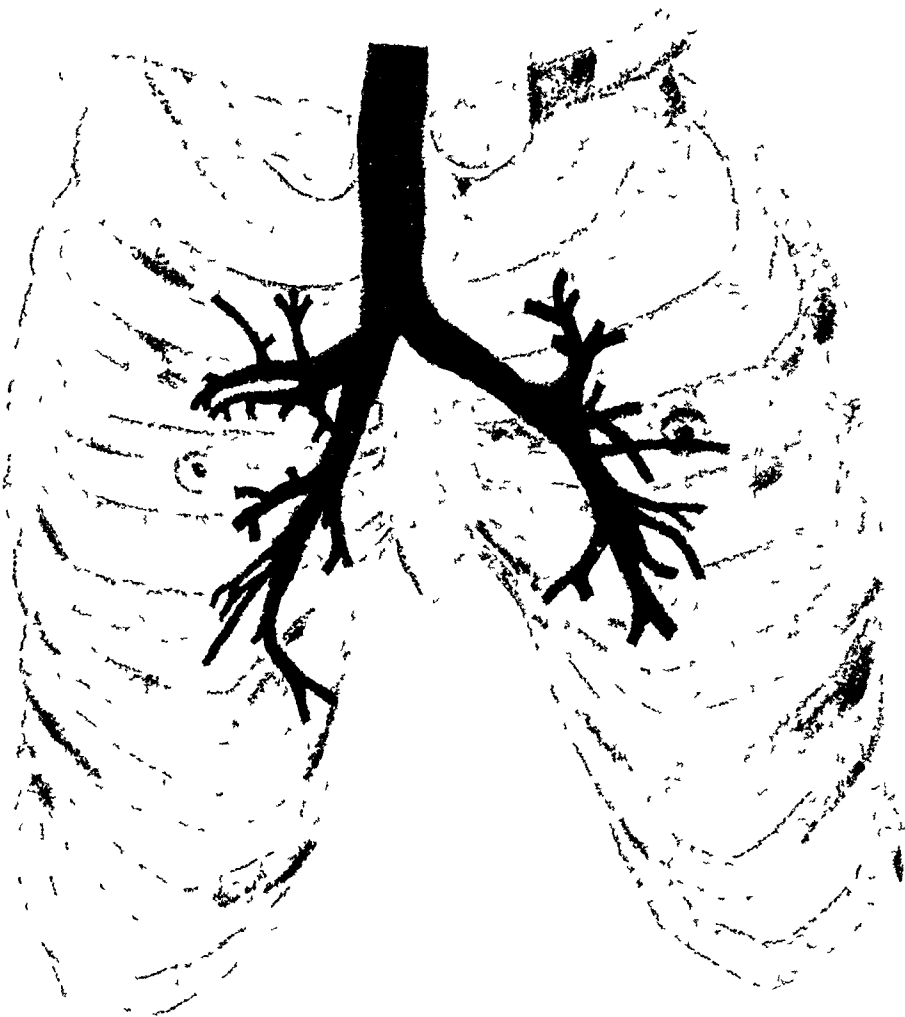


FIG. 9.—Relations of bronchial tree to anterior thoracic wall as shown by X-ray (after Blake)

symptoms so well borne that operation is considered a greater risk than a policy of delay. I personally know of two such cases treated by colleagues.

Operations may have been done and not published or they may have escaped my search.

### ADDITIONAL NOTES AND CONCLUSIONS

A subject so extensive cannot be covered in a paper of reasonable length, but a careful examination of the literature permits the following additional notes to be made.

<sup>6</sup> Journal American Medical Assoc., 1921, vol. LXXVII, p. 1178.  
ANNALS OF SURGERY, 1923, vol. LXVIII, p. 501.

1 The method of Petit de la Villeon was developed at Brest under unique advantages. Thousands of projectiles had been removed from other parts of the body with forceps under the screen where the surgeons had had the cooperation and aid of Doctor LeComiac a radiologist who had examined 21,000 patients since the war began.

2 Indications for extraction are (a) Recurrent hæmoptyses, (b) purulent expectoration (c) dyspnœa on slight exertion (as Dr Robert Didier

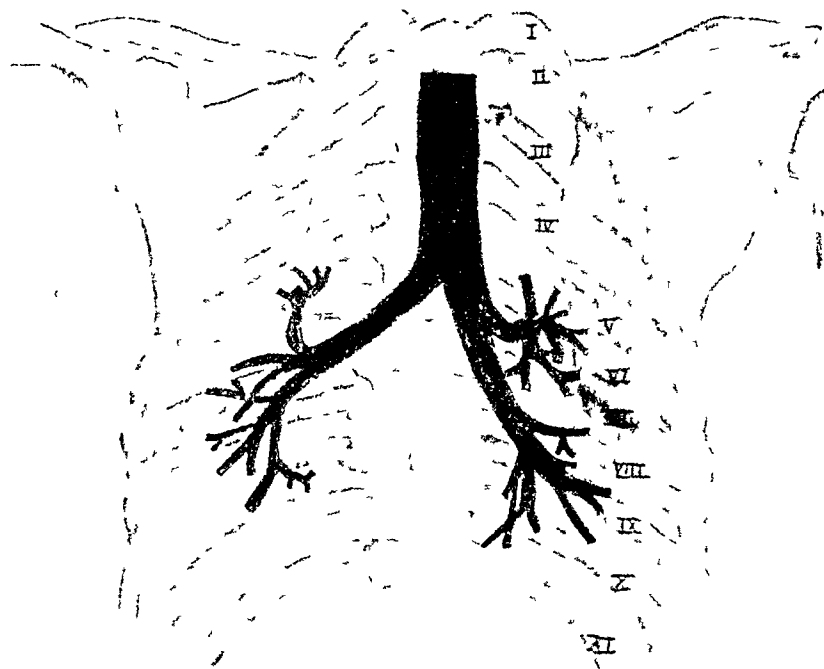


FIG. 10.—Relations of bronchial tree to posterior thoracic wall as shown by X rays (after Blake)

says "Life for such a patient is a perpetual fatigue"), (d) pain (which may be from pleural adhesions), (e) location of the projectile in an extra-hilar region, (f) urgent symptoms in hilar cases, (g) respectable size of the projectile.

3 The favorable time to operate is after the fall of temperature, the disappearance of effusions and after the wound has cicatrized (LeFort).

4 Petit de la Villeon considers essential in his operation (1) The extreme smallness of the buttonhole incision in the skin—just large enough to carry the extracting forceps thus preventing the slightest pneumothorax in nearly every case, (2) careful approximation of the tip of the forceps to the projectile without any misdirections (this to be attained only by much experience), (3) careful separation of the projectile from its bed by manipulation with the tip of the forceps, (4) satisfactory grasp of the projectile in its most favorable diameter and covering any sharp edges of the projectile with the forceps, (5) use of the Kocher forceps for superficial projectiles and his own alligator-jawed blunt-tipped parallel-sided forceps for deep projectiles.

5 Objection has been made to forceps extraction under the screen that while the projectile may be removed debris of clothing may be left and form a focus for infection. Allam in his thesis states that up to October 8, 1918 (253 cases having been then operated) "none has shown an accident of this kind and the healing has always been by first intention."

## EXTRACTION OF PROJECTILES IN THE LUNG

6 Drowning by flooding the bronchi with blood during extraction is so rare as to be negligible. I have noted but one case, Marion's—removal of a projectile at the hilum, treated by tamponade of the wound. In two other cases at the hilum the trachea was flooded with blood, but the patients recovered (Oudard's and Maisquis'). Use of the suction apparatus in the external wound might be preferable to the tamponade.

7 *Projectiles at the hilum and root of the lung* are rather exceptional, for the reason that most of those wounded in this region die before they reach the surgeon (Maudslane).

The hilary zone is not a definitely anatomical region. Practically, however, according to Petit de la Villeon, projectiles in the root of the lung or in the hilary region cast their shadows within a trapezium bounded by the fifth rib above, the eighth rib below, the

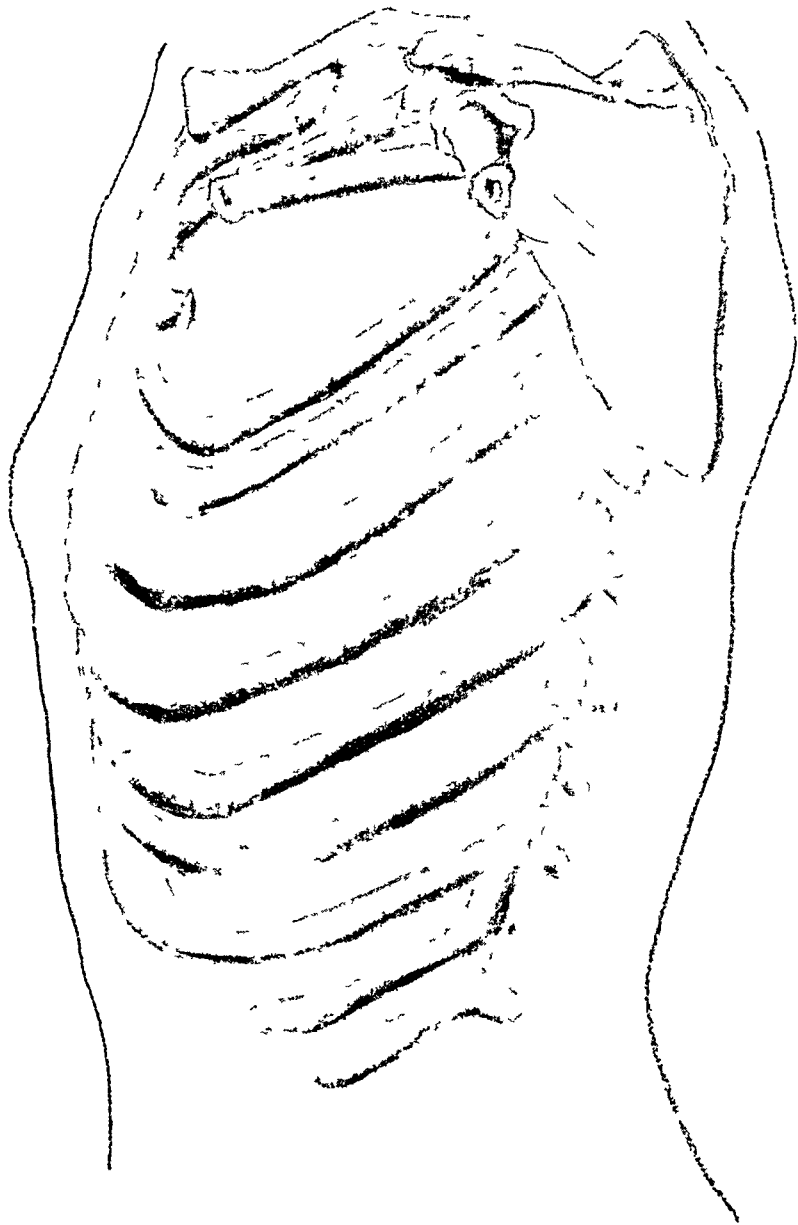


FIG. 11.—Dr. René LeFort's method of exposure of the root of the lung by incision of the third intercostal space and division of the third costal cartilage. *Rev. de Chirurgie* 1917.

inner border of the scapula externally and the vertebral border internally, and are situated at a depth of 6 to 14 centimetres from the skin of the back where the shadow has impinged.

(I must thank Dr. Joseph A. Blake for permission to reproduce a diagram of his, taken from an X-ray plate showing the relation of the bronchial tree to the bony framework of the chest.)

The approach to the hilum may be made from in front where the chest wall is thin and flexible—a location favored by Pierre Duval, René LeFort

and Hallopeau, or from the rear, where the wall is thick and rigid (Petit de la Villeon )

Wide opening of the chest for exposure of the hilum and root of the lung may be made by excision of 5 to 10 centimetres of the second and third rib or by liberal section of the third intercostal space with section of

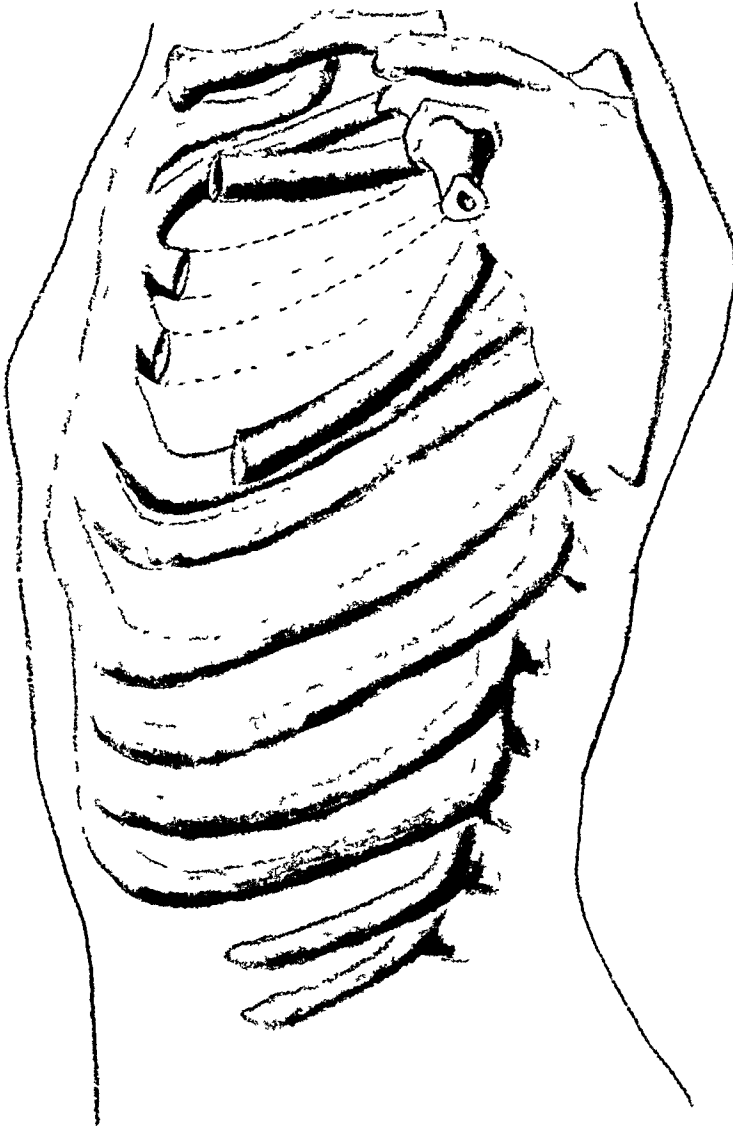


FIG. 12.—Dr René LeFort's method by division of third and fourth costal cartilages. *Revue de Chirurgie* 1917

Dr Petit de la Villeon and reported in detail the first hundred cases done by this procedure to the Surgical Society of Paris in June, 1917. Forty-four of these cases were done by Petit de la Villeon himself and the other 56 by seven other surgeons at Brest.

Not one of these seven surgeons lost a case. Doctor Duval, in making this report, said, "With us and elsewhere, the number of buttonhole extractions is increasing and the number of operators as well."

the second and third costal cartilages, according to the method of LeFort, in either case followed by the use of strong rib spreaders such as Tuffier's or Lilenthal's.

The approach may be made from behind between the scapula and the spine by resection of a portion of the sixth or seventh rib. This passage is deep and restricted in area and gives but hampered access to the fixed and dangerous region of the hilum which must be dealt with in place, as it cannot be delivered.

8 Dr Pierre Duval endorsed the method of

The cases

## EXTRACTION OF PROJECTILES IN THE LUNG

have not been chosen with the intention of making good statistics, they represent the uninterrupted course of our work. LeComiac, as well as our operators, still ignores radio-dermatitis, although some use Mauclair's gloves.

The extraction from the lung by forceps is, with the exception of the hilary region, as harmless as in the buttock, the leg or the arm. The pulmonary tissue is extremely tolerant of the action of the forceps.

Knowing and having the necessary instruments for localization, we do not use them, because our method appears to us so sure and much more rapid.

I have seen five projectiles removed from the thorax of four patients in forty-five minutes by Petit."

*Conclusions of René LeFort—*

The methods for the extraction of intrathoracic projectiles have been greatly improved in the

course of the world war, but the fact must not be lost sight of that, in order to guard against disappointment, interventions of this class must be positively and absolutely left to experienced surgeons, working in suitable surroundings, and never to fledgling operators whose scalpels have been let loose by the war. With these reservations, all disturbing or voluminous intrathoracic projectiles should be removed.

*Robert Didier*, in 1916, said, "Familiarized for a long time with extraction under the screen, we would not dare, up to this time, to approach a projectile of the thorax otherwise than on the radiosopic table. Surgeons who do not wish, or who are not able to accommodate themselves to this method of procedure ought, in the interest of their patients, to give up extractions of old projectiles from the lung."

Many French surgeons have practiced exclusively one of the four typical operations mentioned above, but many others have selected the method of operation best adapted, in their judgment, to the case in hand, and have even switched during operation from one procedure to the other according to the exigencies of the case.

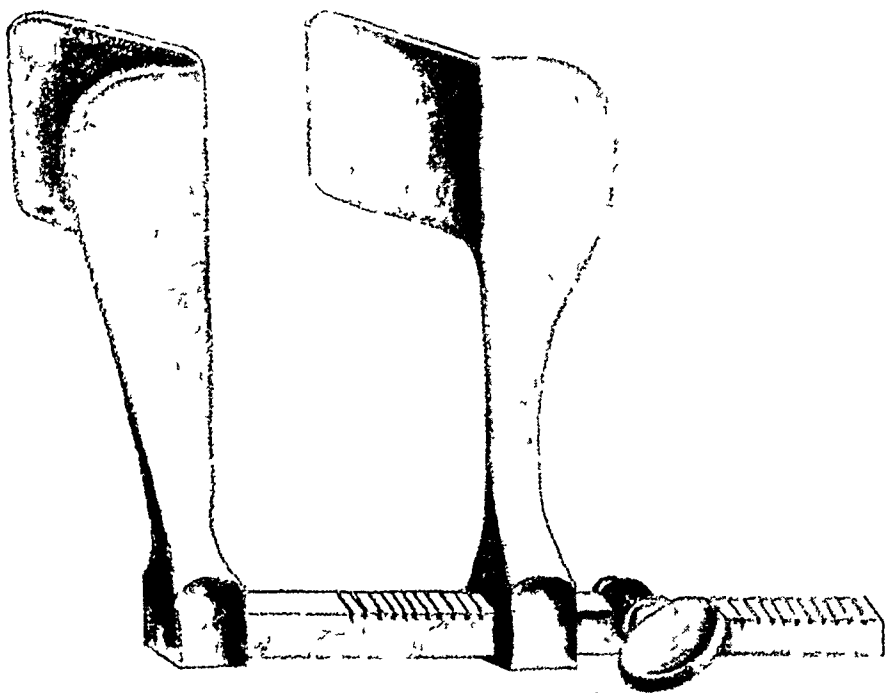


FIG. 13—Tuffier's rib-spreader

It should be said, however, that whatever plan a French surgeon adopted his results were almost always good

I am deeply indebted to a number of distinguished French surgeons, not mentioned above, for information received by personal letters which add to and emphasize that which they have already published

Dr Louis Desgouttes states that he has operated on 55 patients carrying projectiles in their lungs In only one case did he fail to remove the projectile All the patients recovered He always operated by the same method, a slight

modification of Marion's His localization was made with the Compass of Hirtz an improved form of the Compass of Marion "The late results are good but difficult to judge, because the old wounded have a tendency to complain in order to keep their pensions as wounded soldiers or increase them"

Dr G Ico has made many extrac-

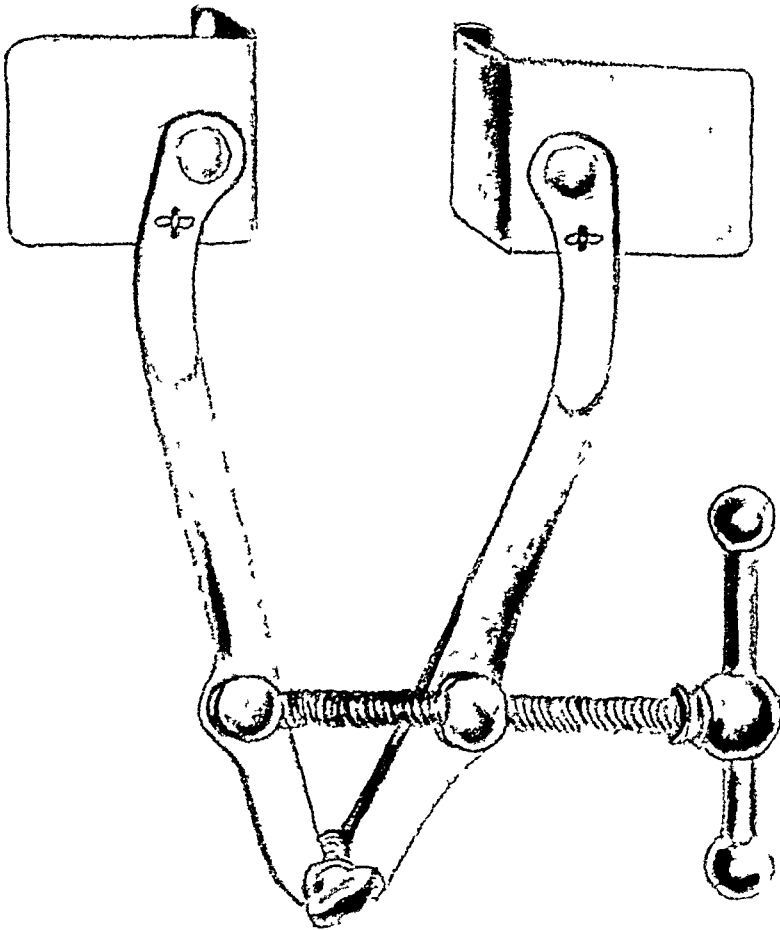


FIG 14 —Lilienthal's rib spreader

tions with success using always the open method of Dr Pierre Duval Some of his patients also are disposed to magnify their symptoms in order to increase their pension rate

Dr Rene LeFort has sent me the outline of a case, which he recently operated very similar in its clinical course to my own The projectile had been carried six years He removed it by the method of Marion with success Doctor LeFort also uses the procedure of Petit de la Villcon and his own modification of Pierre Duval's

Dr Victor Pauchet has extracted ten projectiles without loss of a patient and prefers the method of Petit de la Villcon

## EXTRACTION OF PROJECTILES IN THE LUNG

### SUMMARY

1 Extraction of projectiles long resident in the lung by French surgeons has been wonderfully successful

2 Opportunity for such extractions in this country is so infrequent that no surgeon in peace times is likely to acquire the skill and dexterity necessary to remove projectiles by the method of Petit de la Villeon, except in the easiest cases

3 Projectiles in the root of the lung or in the hilary regions should not be removed unless they provoke symptoms, and then should be approached by the open operation of Pierre Duval or by the method of Rene LeFort, in any case, such operations should be reserved for surgeons accustomed to open lung surgery

4 For the extra-hilary cases, with symptoms urging to operation, in the hands of general surgeons, the operation of Marion is to be advised, as requiring no unusual technical skill and as giving an extremely low mortality

\*            \*            \*

I must thank also my hospital colleague, Dr Paul R Sieber, for his description of Dr Petit de la Villeon's work, of which he was an eye witness, and the information acquired from him, after this paper was written, that he (Doctor Sieber) had successfully extracted intrapulmonary projectiles in four cases in France after he had acquired skill in working under the screen in other less vital parts



# AN EVALUATION OF PRE-OPERATIVE AND POST-OPERATIVE RADIATION IN THE TREATMENT OF MAMMARY CARCINOMA\*

A PRELIMINARY REPORT

By BURTON J. LEE, M.D.

AND

RALPH E. HERENDEEN, M.D.

OF NEW YORK, N.Y.

**INTRODUCTION**—In view of the varying opinions, as to the value of radiation as an adjunct to surgery in the treatment of mammary cancer we are presenting herewith a comparative study of the results obtained in a series of cases treated surgically with and without X-radiation. The material for the paper is furnished by patients admitted to the New York Hospital and to the Memorial Hospital during the period from April 1, 1919, to April 1, 1922. Therefore in all cases under report, the shortest time limit after treatment is three years. The reason for selecting the date of April 1, 1919, lies in the fact that little attempt at a systematic use of pre-operative radiation had been made at the Memorial Hospital prior to this date. For some time however Doctors Janeway, Stone and Quick had been employing radiation before operation in a few isolated cases and had been impressed with its possibilities. From about this date a properly planned cooperative effort has been made by surgeon and radiologist, in an attempt to apply pre-operative radiation in the treatment of this disease. In order that some fair basis of comparison can be reached it has seemed to us necessary that the purely surgical and the post-operative cases should also be those admitted during the same period. The time factor is therefore a constant one.

All patients under consideration have been divided into three groups. Group 1 consists of those in which pre-operative radiation was employed and in the major number post-operative radiation was also used, group 2 includes those individuals treated only by post-operative radiation while group 3 contains those patients who were treated surgically without any radiation. Through the courtesy of Doctors Gibson and Pool and their associates at the New York Hospital the data upon the purely surgical cases have been made available to the writers and our colleagues at the Memorial Hospital have also permitted us to include certain patients in the radiated groups.

We appreciate that in such a study there are many factors which may influence the percentage figures in any one of the three groups studied. The total number of patients is 92 and in such a small number a slight variation in any one of the factors may alter considerably the percentage figure.

---

\* Read before the American Surgical Association May 5 1925

## RADIUM IN BREAST CANCERS

Among these factors of possible variation are the number of cases in each group, the surgical judgment exercised as to operability, the age factor, the character of the disease and the extent of involvement of axillary nodes

*The number of cases in each group* is roughly comparable, there being 31 in the pre-operative—post-operative group, 36 in the post-operative group, and 25 in the purely surgical series

*The Criteria of Operability*—A possible source of variation in result might be found in a difference of judgment as to what constitutes operability. Patients in the pre-operative group came from the Memorial Hospital, while the patients in the post-operative series were referred to us from various hospitals in and about New York, with a considerable number from some of the larger clinics. The patients in the purely surgical group came from the New York Hospital. We believe it is fair to assume that, in general, the cross-section of surgical judgment was the same in all three groups

*Age Factor*—It will be readily seen by a glance at the following table that the ages in the three different groups allow a fair comparison

TABLE I

### *Age Factor*

	Youngest	Oldest	Average Age	Mean Age
Pre-operative	31	78	48	54
Post-operative	28	69	48	48
Surgical	24	75	46	49

*Factor of Pathology*—In order to show to what extent these three groups may be comparable from the pathological standpoint, we have drawn up the following chart, which illustrates the number of cases of various pathological types in all three groups

TABLE II

### *Pathological Types*

	Pre-operative	Post-operative	Surgical
Fibro ca	6	8	6
Adeno ca	2	4	4
Ca simplex	6	5	2
Medullary ca	0	3	2
Infiltrating ca	3	1	1
Very cellular ca	1	0	3
Papillary cyst adeno ca	2	2	1
Duct ca	1	1	0
Sweat gland ca	2	1	0
Large alveolar ca	1	0	0
Small alveolar ca	1	0	0
Gelatinous ca	0	1	1
Ca (type not stated)	6	10	6

It is confusing to attempt to compare the three groups from the pathological standpoint, when so many histological terms are used. Different patholo-

gists often apply different terms to similar histological pictures. Moreover the cases termed carcinoma (unqualified) are to be interpreted as indicating infiltrating carcinoma of more or less active types. Moreover in radiated cases, more fibrosis and lymphocytes reaction is encountered giving a tendency to under-rate the original malignancy. A fair comparison will be possible if all cases are placed in one of the three histological groups, namely papillary cyst adenocarcinoma, adenocarcinoma and infiltrating carcinoma. On this basis the following table had been prepared

TABLE IIa  
*Pathological*

	Pre operative	Post-operative	Surgical
Papillary cyst adeno ca	2	2	1
Adeno ca	2	4	4
Infiltrating ca	27	30	20

It will be readily seen from a study of this chart that no one group contains a preponderance of relatively benign or highly malignant histological types.

*Involvement of Axillary Nodes*—The following chart shows the number of cases in each group with and without involvement of axillary nodes as proved by microscopical examination of the specimen.

TABLE III  
*Involvement of Axillary Nodes*

	Nodes involved	Nodes uninvolved	Not stated
Pre-operative	16-57%	12	3
Post-operative	21-81%	6	9
Surgical	15-79%	4	6

It is apparent that there is little variation in the post-operative and surgical groups with respect to the percentage of cases showing involvement of nodes and from this standpoint therefore these two groups are comparable. The pre-operative group shows a definitely smaller percentage of patients with axillary involvement and for this reason alone should be expected to give a better percentage of good end results.

*The Degree of Malignancy of the Process in Each Patient*—However we believe that the most important method of comparison should be one in which the degree of malignancy is established for each patient taking into consideration the important factors of age, rate of growth, histological appearance and extent of involvement of axillary nodes. On this basis all cases have been placed in one of the three classes: 1. Relatively benign, 2. Moderately malignant and 3. Very malignant. The following chart indicates the types of cases which have been in each of these three classes.

# RADIUM IN BREAST CANCERS

TABLE IV

*The Degree of Malignancy of the Process in Each Patient*

1 Relatively benign	<i>a</i> Papillary cyst adeno carcinoma <i>b</i> Fibro-carcinoma in elderly women without axillary node involvement <i>c</i> Small adeno carcinoma in middle-aged and older women, without axillary node involvement
2 Moderately malignant	<i>a</i> All other cases without axillary node involvement, except those showing marked anaplasia microscopically <i>b</i> Fibro-carcinoma in old women, with axillary node involvement
3 Very malignant	<i>a</i> All young women with infiltrating carcinoma <i>b</i> All cases showing marked anaplasia by histological study, regardless of age or node involvement <i>c</i> All cases with involvement of axillary nodes, except the older women with fibro-carcinoma or papillary carcinoma

On this basis the following chart has been prepared indicating the number of patients in each of the three classes according to the degree of malignancy

TABLE V

*Degree of Malignancy*

	Pre-operative	Post-operative	Surgical
Relatively benign	3-10%	3-8%	1-4%
Moderately malignant	12-39%	14-39%	7-28%
Very malignant	16-52%	19-53%	17-68%

A careful study of this chart reveals that the pre-operative and the post-operative groups contain a larger number of relatively benign cases than does the purely surgical group. All of these relatively benign are at present alive and well and, we believe, that a fairer comparison can be made if they are excluded entirely from consideration.

TABLE VI

*Degree of Malignancy, Relatively Benign Cases Excluded*

	Pre-operative	Post-operative	Surgical
Moderately malignant	12-43%	14-42%	7-29%
Very malignant	16-57%	19-58%	17-71%

A glance at this table will show that the proportion of highly malignant cases in the pre-operative and the post-operative groups is practically identical, whereas in the purely surgical group a somewhat larger number of cases of serious types is found. The end result in the surgical group as compared to the two other groups should show a somewhat lower percentage figure of good result.

Although the number of patients studied is small, we feel convinced that the three groups are comparable for comparative statistical study.

The following chart has been prepared showing the number of patients in all three groups alive and well, dead and recurrent.

# LEE AND HERENDEEN

TABLE VII

	<i>Results</i>		
	Alive and Well	Dead	Recurrent
Pre-operative	16-52%	11	4
Post-operative	14-39%	17	5
Surgical	6-24%	16	3

The following chart has been prepared showing the number of patients of moderately malignant and highly malignant types alive and well, dead and recurrent, having rejected from consideration the relatively benign patients in all three groups. This chart should show more accurately the actual value of radiation in the treatment of this disease, and we believe that all statistical studies of cancer of the breast should likewise exclude the relatively benign cases.

TABLE VIII

	<i>Results</i>		
	Alive and Well	Dead	Recurrent
(Excluding relatively benign cases all of whom are alive and well)			
Pre-operative	13-46%	11	4
Post-operative	11-33%	17	5
Surgical	5-21%	16	3

It is immediately evident that the higher percentage of the more malignant cases in the surgical group (71 per cent) could not explain the striking difference in the percentage figure of those alive and well as compared with the two other groups (57 per cent) and (58 per cent). Further, it will be recalled that the percentage of (79 per cent) surgical cases with nodes involved was considerably higher than the figure (57 per cent) for the pre-operative group, but practically identical with that for the post-operative series (81 per cent). A careful comparison of these percentage figures would justify a somewhat poorer end result for surgery as compared with the pre-operative group, but it could not explain the strikingly low percentage figure obtained. A comparison between the surgical and the post-operative groups also would justify a slightly poorer end result for surgery, but not a figure two-thirds that of the radiated cases.

Our study, therefore, reveals that the relatively poor results in the surgical group must be largely explained by the fact that no radiation was applied in the treatment of these patients. Therefore we are convinced that the results obtained at the Memorial Hospital from the use of radiation as an adjunct to surgery in the treatment of mammary carcinoma demonstrates without question the efficacy of this form of therapy. Further, our study shows that the use of pre-operative radiation adds considerably to the good end result to be obtained over post-operative radiation.

## PRE-OPERATIVE RADIATION

*Upon What Basis is Pre-operative Radiation Employed?*—Many surgeons object to the use of pre-operative radiation upon the ground that it entails unnecessary delay in proceeding with operation and because they question its

## RADIUM IN BREAST CANCERS

efficacy This view would, perhaps, be justifiable if there were not a better percentage of good results in the patients in whom this procedure was employed as compared to those treated only post-operatively

The basis for use of pre-operative radiation depends partly upon clinical experience and partly upon histological evidence Our clinical experience at the Memorial Hospital has demonstrated that many cases of mammary cancer show a partial regression within a few days up to a few weeks This diminution in size is a rule rather than an exception Tumors become better defined and in some of our inoperable cases definite mobility has been obtained where formerly fixation to deeper parts had been present The more malignant the tumor the more ready its response to radiation and the more extensive are its clinical evidences of regression Our clinical experiences, therefore, strongly favor the use of radiation prior to operation to convert temporarily, at least, a growing tumor into a regressive one

From a study of histological evidence at the Memorial Hospital, Ewing believes that the changes taking place in the environment of the tumor following radiation act as a mechanical barrier, to the dissemination of tumor cells during the operation These changes in the surrounding tissues are briefly, at first, dilation of the blood-vessels, serous exudation, lymphocytic infiltration, and later, a beginning endarteritis and a proliferation of connective-tissue cells

Further the degenerative changes taking place in the tumor itself, probably dependent both upon primary changes in the tumor itself, as well as those occurring in the surrounding tissue We believe that this degenerative process renders dislodged cells less viable wherever they may be carried Moreover, the changes induced by radiation in the environment of the tumor furnish a less favorable soil in which remaining tumor cells may grow

### TECHNIC OF PRE-OPERATIVE RADIATION

*Intervals of Treatment*—In general, we have found that where treatments are given in two to three-day intervals, the patient is less apt to be disturbed by radiation sickness than when treatments are on succeeding days The patient is more likely to complete the whole cycle It is important to explain to the patient what symptoms are liable to appear as a result of the treatment and, also, to inform her that rest combined with free catharsis and an alkaline diet are desirable, and close contact should be maintained with the patient during this period Surgeons should familiarize themselves with the effects of radiation both local and general and should consult with the roentgenologist concerning these matters and the details of treatment employed

*The Areas to be Treated*—As a rule we expose four areas—namely the first two over the breast proper, the last two over the axilla and supraclavicular regions The first treatment over the breast proper is from in front and the second is from the side, thus using an additional portal of entry and, thereby, doubling the dose to the tumor and its environment The latter two augment the dose into the axilla The axilla is irradiated whether or not axillary nodes

are palpable, for we have shown that there is a possibility of error of 15 per cent in determining the presence or absence of involved axillary nodes

A large area is exposed at each treatment and in the average case measures 15 x 15 cm. The reasons for using such a large area are numerous. The first is that the entire disease and the surrounding normal tissues may be fully irradiated for if one limits radiation only to the palpable tumor, we fear that, in some instance, outlying non-palpable disease or its environment might escape radiation. Another reason for selecting large areas is that the larger the skin surface, the greater will be the depth dose because of the scattered radiation produced. Further, it seems desirable to limit the actual number of treatments and the number of visits in so far as is consistent with the administration of an adequate dose.

*The Dose to be Employed*—The time of exposure has varied with the area treated from 7 to 15 minutes over the breast itself and from 15 to 25 minutes over the axilla and supraclavicular areas. The shorter exposures were in the earlier years but the tendency has been to lengthen the time and more recently the 25-minute exposures have permitted an intermediate dose between the usual low voltage and high voltage. The voltage employed is 140 kv with 4 milliamperes of current backing up a 10-inch spark gap with 4 millimetres of aluminum filter at a target skin distance of 10 to 12 or 15 inches. This dose is usually followed by a first-degree erythema, appearing in from one to two weeks, and followed by a slight pigmentation which is apparent in from three to five weeks. The treatments, therefore, extend over a period of about ten days.

In applying radiation every patient must be considered as a distinct clinical problem apart from any other patient and the radiation to be given must be determined as the best for that patient.

*The Interval between the Last Treatment and Operation*—Although many of the patients in this report were operated upon a few days after the last exposure we feel that best results may be obtained if an interval of at least three weeks is allowed to elapse before operation is undertaken. By this time the histological changes in the tumor and environment are more fully established.

*Does Pre-operative Radiation Make Operation More Difficult?*—In our experience with the cases treated in this manner, an operation performed any time from a few days to a few weeks after radiation is attended with no additional difficulties. It is only in those cases operated upon some months after massive over-radiation where the operator may encounter some fibrosis. Further, when operation is undertaken a few days after radiation, additional hæmostases may be necessary because of the post-radiation hyperanæmia present.

*Does Pre-operative Radiation Affect Wound Healing and Does It Invite Wound Infection?*—We have seen as many cases with delayed wound healing where surgery has been used without any preliminary radiation as where a pre-operative cycle has been employed. With the technic carried out at the

## RADIUM IN BREAST CANCERS

Memorial Hospital, which does not attempt a massive gross destruction of tumor process by very heavy radiation, wound healing has been satisfactory. When heavy dosage has been employed an operation undertaken a few days later, at the height of the inflammatory reaction may result in delayed healing and invite wound infection, but we have seen no such results at the Memorial Hospital.

### POST-OPERATIVE RADIATION

*Upon What Basis is Post-operative Radiation Employed?*—In general surgeons have been more willing to submit their patients to post-operative radiation than to pre-operative treatment in the belief that the likelihood of local recurrence in the operative field was thereby diminished.

An opportunity to observe a large number of recurrent cases at the Memorial Hospital sent to us from the local clinics in and about New York leads to the inevitable conclusion that, even with the best surgical technic, dislodged tumor cells may be left in the operative field, or have escaped removal. This being the case, the reason for using post-operative X-ray is immediately apparent. In proper dosage it produces similar changes to those already outlined under pre-operative radiation, namely an inflammatory reaction in the tissues of the operative field which thereby become less favorable as a soil for the growth of tumor cells present. It also induces similar degenerative changes in tumor cells remaining.

### TECHNIC OF POST-OPERATIVE RADIATION

*Intervals of Treatment and Areas to be Treated*—These are usually given twice a week, the same area being exposed as in the pre-operative cycle.

*The Dose to be Employed*—The dose used over the supraclavicular and axillary spaces is relatively somewhat heavier than those over the anterior chest wall, the technic being the same as that already described under pre-operative radiation.

The breast having been removed, only a superficial dose is necessary over the anterior chest wall, whereas for the axilla and the supraclavicular regions, a relatively greater depth dose seems indicated.

*The Interval between Operation and the Beginning of the Treatment*—Treatments are begun from two weeks to one month after operation when the wound has entirely healed and the patient has fully convalesced. A period of about five weeks should be allowed to elapse between the last pre-operative exposure and the first post-operative treatment. This dose may be repeated once or twice the cycles being separated by intervals of two to three months. At present it seems highly desirable to follow such a plan of repeated fractionated dosage rather than to rely upon a single massive dose given post-operatively.

*The Importance of Correct Dosage*—The results obtained in the treatment of mammary carcinoma by X-radiation depend very largely upon the dose administered. So small a dosage may be employed that practically nothing



may be accomplished. It is also true that such heavy doses may be used that the patient's local and general resistance against the disease may be markedly lower. Numerous reports may be found in the literature corroborating this statement.

#### CONCLUSIONS

1 Although the series includes a relatively small number of patients, the present study has convinced us that pre-operative and post-operative radiation are of value as an adjunct to surgery in the treatment of carcinoma of the breast.

2 The best results were obtained when both pre-operative and post-operative radiation were employed.

3 The end results will be largely determined by the plan of X-radiation followed and the dosage employed.

# SPLENECTOMY FOR PURPURA HEMORRHAGICA<sup>\*</sup>

BY MALVERN B. CLOPTON, M.D.

OF ST. LOUIS, MO.

FROM THE SURGICAL DEPARTMENT OF THE WASHINGTON UNIVERSITY MEDICAL SCHOOL

IN THE past decade since splenectomy has been practiced for purpura hemorrhagica, there has been sufficient experience to make us feel that the results are more encouraging than in any other comparable group of blood diseases of uncertain origin, except perhaps in hæmolytic jaundice treated by splenectomy. The acceptance of splenectomy as a curative procedure has led to the reporting of brilliant results as observed immediately after operation, and one can easily understand the enthusiasm of the observers who have seen the almost hopeless situation change into a progressive improvement immediately following splenectomy. While a few of the cases have been reported in sufficient detail in their after course over a long period, one may think that perhaps our statistical reports are charged with a greater optimism than is justified until all these cases have been followed for several years.

As a clinical entity purpura hemorrhagica has been fairly defined for about 150 years (*Morbus Maculosis Werlhofii*), but our ignorance of the true nature of the disease leaves its place in the classification of purpuras in controversy. More recently, it has been suggested that primary purpuras be classified into (1) those in which there is a diminution or apparent absence of platelets, (2) those that have no change in the number of platelets, the latter probably resulting from changes in the capillaries or in other elements of the blood.

In the study of some cases with purpura and bleeding, we find difficulty in definitely placing them, but we can accept for our purpose a definition of purpura hemorrhagica as a disease usually beginning in early life, but which may come on at any age, showing petechia or purpuric spots, with serious hemorrhages from the gums or mucous membranes, with secondary anaemia (commensurate with the severity of the bleeding), the disease having remissions, or coming in cycles, and usually progressing with each attack. The small number of platelets or their absence, the prolonged bleeding time, the normal coagulation time, and the failure of the clot to retract, are the outstanding blood findings.

The spleen may or may not show an enlargement. There is an acute form which may prove rapidly fatal, and a chronic form which may continue over years.

To review at length the various opinions of this disease and the conflicting views expressed about the relation of the different blood factors is hardly necessary as this has been so recently and ably done by several observers (Bull, Krumbhaar, Cohn).

The platelets, which are found in such small numbers or entirely lacking in

---

\* Read before the American Surgical Association, May 5, 1925

all cases of purpura hemorrhagica, play an important role and Eppinger believes the disease should be called thrombocytopenic purpura hemorrhagica. Their absence in purpura was first noted by Denys in 1887. Wright's demon-

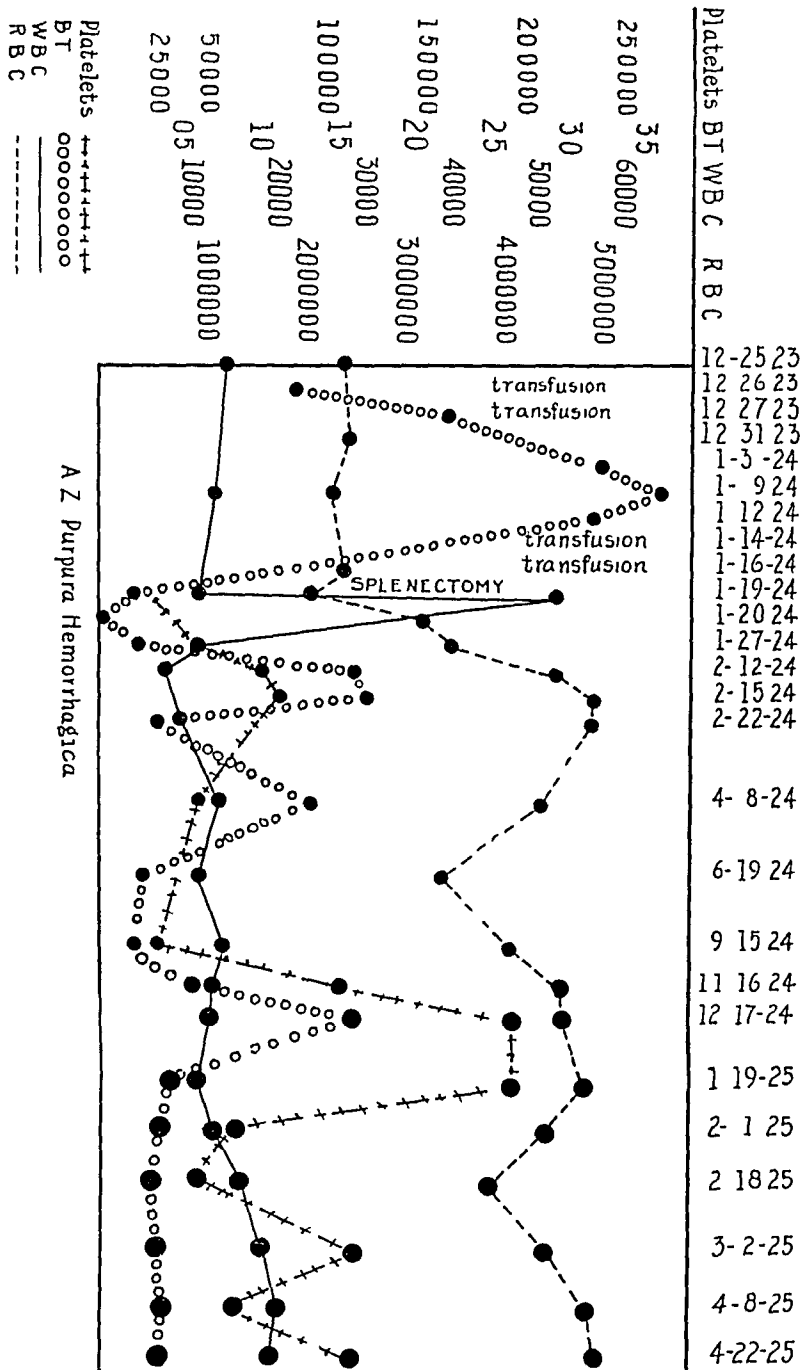


FIG. 1—Chart showing influence of splenectomy upon the number of platelets in the blood

stration of the origin of platelets in the megacaryocytes of the blood-forming organs has been generally accepted, and this function is probably normally maintained in purpura. They are considered to supply a thromboplastic substance that hastens coagulation. If the platelets are formed in normal numbers we must account for their disappearance. Karsnelson believes that the destruction of the platelets takes place in a diseased spleen, because he found a large number of platelets in the lymph-spaces of the spleen. Frank, on the other hand, thinks that there is a failure of the megacaryocytes of the bone-marrow to produce platelets and that the bone-marrow is activated to increased platelet production by splenectomy.

## SPLENECTOMY FOR PURPURA HEMORRHAGICA

The blood in purpura hemorrhagica clots normally, but the failure of the clot to retract, as normal blood does within an hour, is probably due to the lack of platelets. This at once differentiates this group of bleeders from hæmophiliacs, whose clotting time is markedly delayed and imperfectly executed, though after clot formation, clot retraction takes place, as the number of platelets in hæmophilia is normal.

The bleeding time in purpura is prolonged which is probably due in part to a vulnerability of the capillary vessels. This capillary weakness, combined with changes in the blood itself, accounts for the appearance of petechiæ, purpuras or ecchymoses of the skin and mucous membranes, and the hemorrhages that may occur from the gums, nose, stomach, kidneys and uterus or beneath the retina. Hemorrhages do not stop with the administration or application of any known remedy.

The anæmia that develops with the repeated hemorrhages varies with the amount of blood lost, and the capacity of the bone-marrow to form new cells. There may be no leucocytosis, but if it is present the increase is largely due to the increase in the mononuclear lymphocytes.

Kaznelson in 1916 suggested splenectomy in these cases and since then a number of reports of results following operation have been published.

Krumbhaar has collected 27 cases with two post-operative deaths (7.4 per cent mortality) and no subsequent deaths. One of these cases was unimproved, 9 were improved, and 15 were apparently well. To these 27 cases I have been able to add 18 more, making a total of 45 cases with two operative deaths, 27 are regarded as well, 15 improved and one unimproved.

Two cases, from the St. Louis Children's Hospital, have been operated by me, both of them over fifteen months since, one with such marked improvement that it can reasonably be called a cure, the other with marked improvement, but with occasional hemorrhages that are easily controlled. A more recent case in the Barnes Hospital, a woman thirty-four years old, has had no reappearance of purpura or hemorrhages since her operation eight months ago.

The two cases in children had their first indication of the illness at the age of five years, one began as a mild apparently simple purpura with only skin manifestations but became severe after repeated nose bleeds, which started during a bad cold and otitis media. The other began with an influenza, the petechiæ and purpuric spots showing in successive crops before the bleeding started from the nose and gums. Both had been given numerous remedies by mouth and subcutaneously without effect. Transfusions had been repeated and not only had there been no influence on the bleeding, but on two occasions with the boy, fresh skin lesions and bleeding appeared almost immediately after the transfusions, an occurrence which was noted by Brill, who states that he thinks transfusion of blood has no curative effect, with which we agree. The anæmia was marked, the boy showing a red count of 3,600,000 and the girl showed a count of 2,500,000 red cells after a transfusion that had been given to her immediately on admission because of extreme weakness. The boy came to operation almost exsanguinated from his bleeding which repeated transfusions failed to combat. He was a bad risk for operation and it appeared for a time rather dubious whether he would survive the shock, despite the transfusion started during the operation. The girl was in better condition for operation and responded well to the transfusion given at the time of operation. After removal

of the spleen from the boy, the oozing seemed to stop immediately from the surfaces left exposed by the tearing of adhesions. One hour later, the bleeding time was less than a minute, while it had been thirteen minutes before operation. The girl's bleeding time before operation had varied from thirty-seven minutes, seven days before operation to twelve minutes as she came to the operating room. Shortly after the operation the bleeding time was two minutes and bleeding from the nose was noted as stopping while the child was still on the operating table. The spleen in each instance was normal to

microscopic examination. The one from the boy was rather large, the other normal in size. The short bleeding time persisted for a considerable period after splenectomy. In each case there was an immediate increase in the leucocyte count, with the boy, who had a count of 12,000 before operation, there was a jump to 59,000 in two days—with the girl, from 11,000 before operation to 53,000 the evening of the same day. The smears of the blood of the boy showed a remarkable pouring out of normoblasts and megaloblasts in several fields as many as five or six nucleated reds. The girl showed only a few nucleated reds after operation.

The platelets, which had been

hard to find before operation, showed on smears of the boy's blood a few hours after operation, but it was two weeks before they could be counted as much increased, when they numbered 60,000. They rose to 95,000 six weeks after operation, and during the first few months never got any higher, in fact, they appeared to gradually reduce in number, but the amount nine months after operation showed they were 150,000. The other child showed a few platelets on the smears six hours after operation, but it wasn't until ten days after operation that they were noted at 50,000, slowly rising to 90,000 one month after operation, and ten months after operation the count was 200,000, which is her highest count. There have been some variations in the count which I will discuss later.

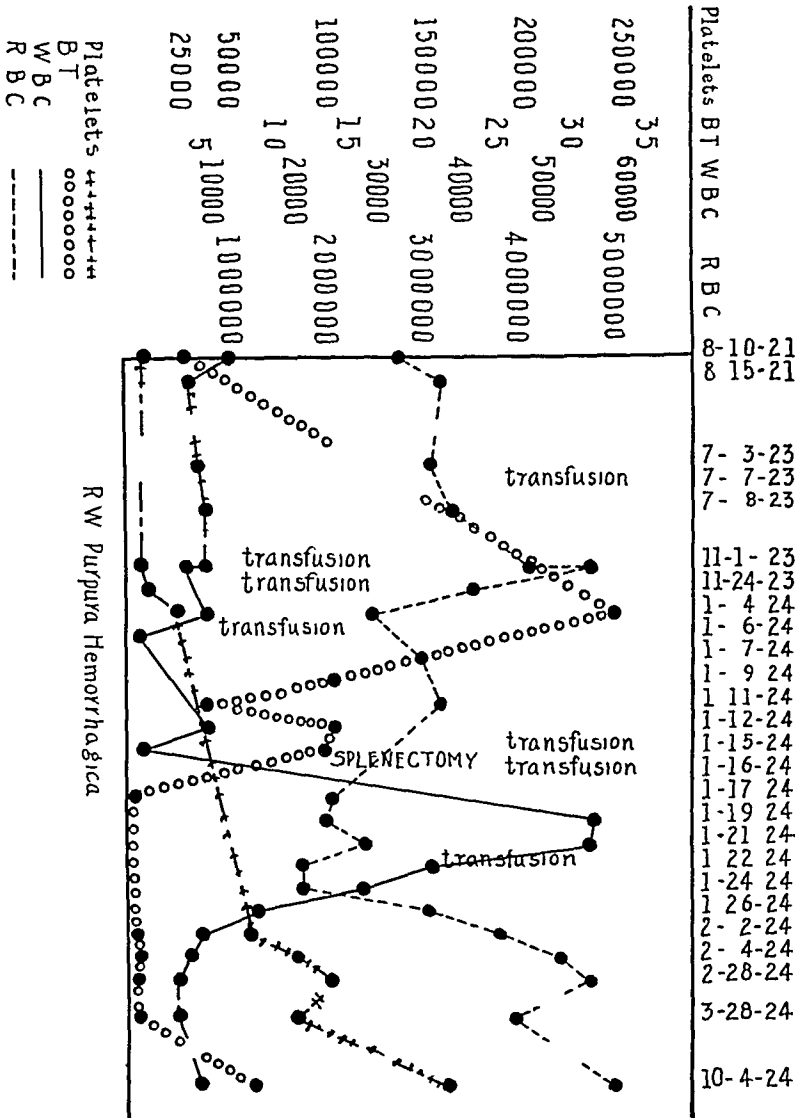


FIG. 2—Chart showing the influence of splenectomy on the number of platelets in the blood

## SPLENECTOMY FOR PURPURA HEMORRHAGICA

The bleeding time remained at the low level in both cases for some time, and during this period there was no bleeding except an occasional slight oozing from points in the nose where previous to operation there had been brisk hemorrhages. This later oozing stopped either spontaneously or after pressure on the outside of the nostril and did not require packing.

While the boy's bleeding time remained about two minutes, he had several small hemorrhages from the nose at long intervals, from an ulcer on the septum. A virulent culture of diphtheria bacilli was grown from the nose, but whether the ulcer was due to this infection, or a result of the old weakness, one cannot say. The ulcer was very sluggish, and on last reporting the boy was still carrying the virulent organisms, but there has been no bleeding, only an occasional purpura, and the youngster is in robust health.

The girl's bleeding time remained low for several months, and there were no hemorrhages, but on one visit to the hospital three months after splenectomy, when she came to have her tonsils removed, the platelets were 50,000, the bleeding time was noted at fourteen minutes and she had a purpuric eruption, therefore, the tonsils were not touched. Eight months after splenectomy the bleeding time had returned to two minutes, but there were petechia and ecchymosis over the body, however no new petechiæ were brought out on the arms when the tourniquet was applied (capillary resistance test of Hess). There were only 20,000 platelets, which made us hesitate to subject her to tonsillectomy, which was indicated because of their large size and the fact that whenever she had an attack of tonsillitis she broke out with many petechiæ and purpuric spots. Under proper care in the country she showed the first marked improvement in general condition since her splenectomy. In the first seven months there had been a gain of only three pounds, but she felt well and seemed strong, while in the next six weeks in the country, she gained four and one-half pounds, and her red count jumped from 3,400,000 to 4,650,000, and the platelets rose to 106,000, with a bleeding time of five and one-half minutes. A month later she had gained in weight to what was normal for her age and height, she seemed robust, and had no anæmia, with a platelet count of 200,000, but a bleeding time of sixteen to twenty-five minutes, which would seem to indicate that there is some other factor than the diminution of platelets which helps determine the long bleeding time. In another month during which she continued to gain, and had not bled, the bleeding time returned to three and one-half minutes. A tonsillectomy was performed under gas oxygen with no more bleeding than is customary after this operation. It is interesting to note that thirty minutes after the operation the child broke out with petechiæ over the face, neck and forearm. These had disappeared in ten days, when the second tonsil was removed and another crop of petechiæ made their appearance within forty-five minutes. The platelet count at this time was 90,000, bleeding time three minutes, and while there was no unusual post-tonsillectomy bleeding, on the succeeding day the child began to bleed profusely from the nose, which had to be packed to control it. It is three months since the tonsils were removed and the child is in excellent health, strength and weight, with 5,000,000 red cells, a platelet count of 120,000 and bleeding time of two minutes, a clotting time of four and one-half minutes but her clot does not retract. During these last few months she has had three hemorrhages from her nose, one quite profuse, and each time we have found the platelets count reduced to 45,000 or 50,000, but the bleeding time, usually determined by the same observer, has been around two minutes. In each instance we believe we could connect the bleeding with an upper respiratory infection.

Another interesting phase of this child's case was that she was practically blind on admission and Dr. Lawrence Post found an optic atrophy, which he thought was due to the extreme anemia following an earlier severe hemorrhage. He regarded the eye condition as stationary, but as her general condition improves she uses her eyes better and has been able to do some work in the hospital school. She will have to complete her education in a school for the blind.

# MALVERN B CLOPTON

The third case, a woman thirty-four years of age, was admitted to the Medical Service of Barnes Hospital on September 22, 1924. One month before she bruised herself and developed a large black and blue area which was slow in disappearing, then other smaller areas and spots on arms and legs were noticed which began as red, turned blue then brown, and disappeared.

Four months before admission, after a severe cold she developed a sinusitis and the left maxillary sinus was operated at the City Hospital. When the packing was removed from the nose there was a severe hemorrhage and subsequently up to September 7, there were several unaccountable hemorrhages from the nose.

On admission to the hospital there were scattered purpuric spots over the legs. The

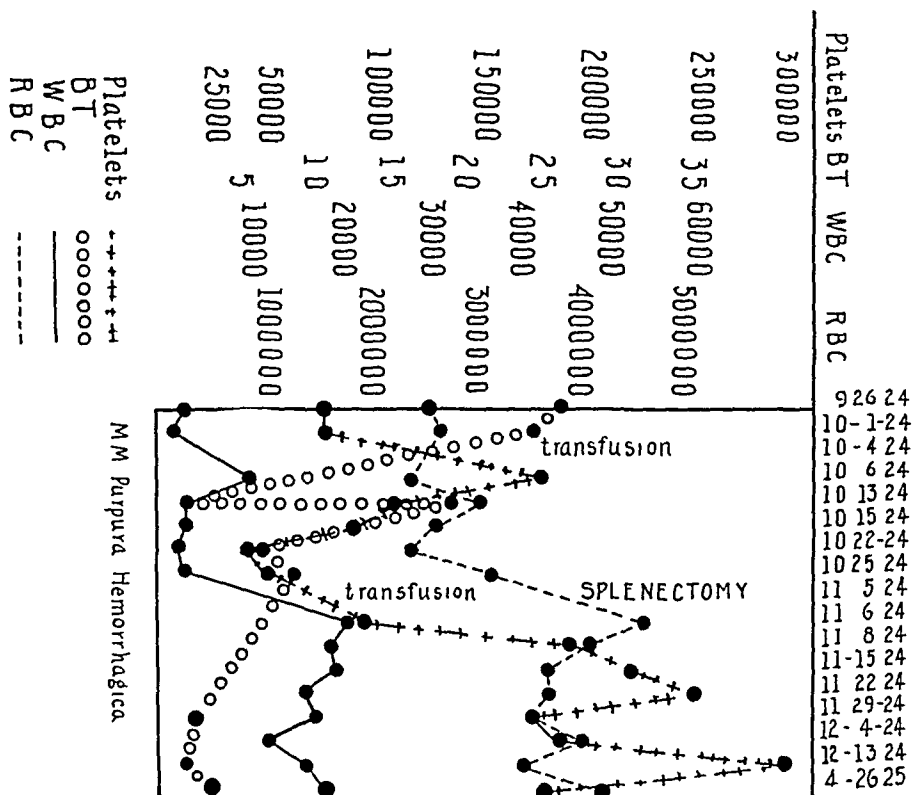


FIG. 3.—Chart showing the influence of splenectomy on the number of platelets in the blood

patient was fat and flabby with marked pallor. The spleen was enlarged, the liver edge could be felt. Red blood-cells 2,700,000, white blood cells 3,500, differential count normal. Hemoglobin 40 per cent, platelets 70,000, bleeding time four minutes, and two days later eight minutes. Clotting time three minutes. Clot did not retract after two hours. There was occult blood in the stool but on admission no other evidence of bleeding.

Patient was transfused and had a severe reaction followed by a herpetic eruption about the lips and subsequently there were hemorrhages from these cold sores and from the gums and nose. The patient was worse after the transfusion. The bleeding time rose from seven minutes before, to nineteen minutes when taken ten days after the transfusion. She developed a transient jaundice.

Through a left rectus incision the enlarged spleen was removed. The liver was cirrhotic. There was no trouble with bleeding from the few adhesions torn during the operation as oozing stopped as soon as the spleen was out. Patient had a stormy time after operation developed a pneumonia of the left base and had a severe cough which

## SPLENECTOMY FOR PURPURA HEMORRHAGICA

broke some of the silkworm gut sutures, and the abdominal wound gave way, requiring a secondary suture ten days later

Despite these serious complications and the very poor condition of the patient before operation, for the first few months she has made a steady improvement. The platelets rose to 250,000 two days after operation and have stayed between 175,000 and 250,000 ever since. The bleeding time dropped to three and one-half minutes and has stayed there since. The leucocytes rose to 20,000 after operation and have not gone below 12,000. The red cells stayed between 4,500,000 after operation and 3,500,000 a month later. The hæmoglobin has increased from 35 per cent to 45 per cent. No purpuric spots have appeared and there has been no bleeding.

The menstruation, which had been prolonged to over a week the two periods before operation and had been most profuse, was recorded as three days and normal since operation.

About four months after the spleen was removed when the patient had gained enough strength to return to her work in a shoe factory, she had a severe injury in an automobile accident, in which she received a fracture of the pelvis and several other bones. No unusual ecchymoses appeared, and there was no unusual bleeding from her wounds. She has recovered in a satisfactory way from these injuries and is up and about. A blood count made almost six months after the splenectomy records red blood-cells 4,060,000, white blood cells 19,600, hæmoglobin 49 per cent, differential count polymorphonuclears 64 per cent, small mononuclears 35 per cent, large mononuclears 1 per cent. Bleeding time two minutes. Clotting time five minutes. Clot retracted in one hour. Platelets 180,000.

With these findings one can feel warranted in expecting a cure of the purpura.

TABLE I  
*Cases of Splenectomy for Purpura Hemorrhagica*

	Cases operated	Well	Improved	Unimproved	Dead
Krumbhaar	27	15	9	1	2
Mayo Clinic	8	4	4		
Vincent	3	3			
Ricardo	2	1	1		
Cohn	1	1			
Blumer	1	1			
Clopton	3	2	1		
	45	27	15	1	2

It would seem that the platelets are the most important factor so far discovered in this disease, and their decrease as is found in purpura hemorrhagica is not explained. The decrease may possibly be due to infection of the upper respiratory tract.

Taking out the spleen has been followed by an increase in the platelet count, not only in purpura hemorrhagica, but in Banti's disease. The platelet count may be slow in rising after splenectomy and it may recede after it has reached a normal number.

The hemorrhages of purpura seem to come when the platelet count is the lowest. The platelet count usually is low with a long bleeding time. The bleeding time is not necessarily short because of a high platelet count, as we have seen a long bleeding time with a high platelet count.

We agree with Brill who feels justified in saying that splenectomy in this



## MALVERN B CLOPTON

disease is a life-saving measure, and should as such be employed in all cases of chronic thrombocytopenic purpura

There is evidence that it is also curative. Kaznelson's first case had no recurrence in a period of over five years.

The risk of operation is obviously greater as the patient is weakened from repeated hemorrhages, and should therefore be performed as early as a positive diagnosis is made. The mortality is surprisingly low in the reported cases.

## BIBLIOGRAPHY

Brill. Am J Med Sc, 1923, vol clxvi, p 503

Krumbhaar. Am J Med Sc, 1923, vol clxvi, p 329

Cohn. Surg, Gyn and Obst, 1924, vol xxxviii, p 596

Kaznelson. Wien klin Wchn Schr, 1916

Ricardo. Bull et Mem Soc d hop Par, 1924, vol xl, p 493 (abst in S G O, September, 1924, p 253)

# THE SEQUELÆ OF GASTRO-ENTEROSTOMY\*

THE INDICATIONS FOR DISCONNECTING THE ANASTOMOSIS, AND THE  
TECHNIC OF THE OPERATION

BY DONALD C BALFOUR, M D

OF ROCHESTER, MINN

OF ALL the operations for benign lesions of the stomach or duodenum gastro-enterostomy has the widest range of usefulness. When indications are adequate, gastro-enterostomy leaves little to be desired, and, when properly performed, immediate and late complications or disappointing sequelæ are rare. It can often be employed when other methods of treatment are contra-indicated, and since simplicity, safety, and efficiency are its outstanding features, it has become the most firmly established surgical operation on the stomach.

Because of the popularity of gastro-enterostomy and because the conditions for which it is performed are either becoming more common or are more often recognized, or both, the operation has been, and is being, performed innumerable times. The results of gastro-enterostomy are not perfect, and no such claim should be made at present for this or any other treatment for chronic peptic ulcer. The imperfect results comprise, in the aggregate, a group which, although small compared to that in which results have been permanently satisfactory, is sufficient to form an apparent basis for criticism of the operation, and to present problems difficult of solution to the internist and, particularly, to the surgeon. In certain of these failures, secondary operation, which usually includes the uncoupling of the anastomosis, becomes advisable, and since this latter group offers some very interesting points for discussion, I have reviewed the 343 cases in the Mayo Clinic, in which the disconnecting of the anastomosis has been at least part of the secondary operation. It is hardly necessary to state that within the compass of one paper such a review can be only general and that this paper is but introductory to the subject.

In these 343 cases ninety-nine of the patients had had the primary operation in the Clinic, and 244 had had it elsewhere. The 343 cases can be divided readily into two groups, those in which the gastro-enterostomy appeared to be unnecessary and those in which it apparently had been necessary. In the first group there are 131 (38 per cent), in the second group 212 (62 per cent).

*Group 1*—The unnecessary gastro-enterostomy is a discredit not to surgery but to the surgeon. In the earlier days of gastric surgery it was not realized that conditions other than ulcer could give rise to symptoms which mimicked perfectly those due to ulcer and consequently gastro-enterostomy was often performed unnecessarily. The operation was also performed

\* Read before the American Surgical Association May 4, 1925.

in cases of digestive disturbance of a purely functional character, for pylorospasm, for the prolapsed atonic stomach, for gastric hemorrhage supposedly due to ulcer but in reality due to causes extraneous to the stomach, and for gastric symptoms due to disease elsewhere in the abdomen. Not only did gastro-enterostomy prove to be useless for all such conditions, but in many cases it added new symptoms to the original complaint.

Since the only basis for gastro-enterostomy is a demonstrable lesion it is usually well to follow the rule that the operation should not be done unless a lesion can be found. The surgeon however, is confronted with a perplexing but fortunately rare, problem when the history is typical of ulcer, when gastro-intestinal hemorrhages have occurred, and when the X-ray report is positive but exploration does not reveal a lesion by the usual methods of inspection and palpation. Under such circumstances the surgeon should inspect the mucosa by opening the duodenum or the stomach, or both, but since the entire mucosa cannot be inspected carefully enough to exclude the possibility of a small superficial lesion, there may be an occasional case in which the pre-operative evidence of ulcer is so definite that gastro-enterostomy is justified. If necessary, the anastomosis may be disconnected later. Another confusing type is that in which there is marked hypertrophy of the pyloric muscle. This hypertrophy may closely simulate the induration of an ulcer but, as Moynihan has pointed out an ulcer crater practically never occurs in the pylorus itself, even though the induration may involve the pyloric ring extensively. A chronic gastric ulcer regardless of its size rarely escapes recognition if a careful search is made because of the induration about the crater and because of the characteristic changes in the serosa at the site of the lesion.

In reviewing the pre-operative histories of this group of 131 cases of unnecessary gastro-enterostomy, the most outstanding fact was the absence of a history on which a diagnosis of ulcer could have been justified at any time.

The evidence that the gastro-enterostomy was unnecessary in these cases is based on (1) the symptoms for which the operation was done, (2) the findings at the time of operation, (3) the effect of the operation on the symptoms, (4) the nature of all the new symptoms, (5) indications that some extra-gastric condition was responsible for the symptoms, and (6) the roentgenologic findings.

The history of the patient before operation is often not only sufficient to rule out ulcer but at the same time it may be typical of some other abdominal disease particularly disease of the gall-bladder or appendix. Information as to the conditions found at the time of the gastro-enterostomy is usually vague and may be entirely lacking, so that little, if any reliance can be placed on information from the patient. The effect of the operation on the symptoms may be beneficial for a short time particularly in the enteroptotic type since such patients are often temporarily improved by any operation or treatment which promises relief and inspires them with new hope. Sooner or later, however, the original complaint returns aggravated by disappoint-

## THE SEQUELÆ OF GASTRO-ENTEROSTOMY

ment, and frequently with new symptoms directly attributable to the useless gastro-enterostomy. Nausea and vomiting are the predominating sequelæ of the unnecessary gastro-enterostomy, the latter may vary from an occasional and slight regurgitation of bile to the type of the true vicious circle with its associated features of loss of weight and appetite, and general disability. Pain is uncommon. In many cases there is sufficient evidence to determine the condition which was responsible for the original complaint which may have been appendicitis, cholecystitis, pancreatitis, splenic disease, colitis, the gastric crises of tabes, or pelvic disease. Fluoroscopic examination is of great aid since it enables one to visualize the stoma, the pylorus, and the duodenum, and when it is suspected that the gastro-enterostomy was unnecessary a roentgenologic report of a free stoma and no deformity of the duodenum is extremely valuable. The indications for operation in such a group of cases are not always clear, but even so the symptoms may be sufficiently distressing to justify exploration, and with the approval of the patient it may be undertaken, to determine whether the anastomosis is of any service, and to learn whether any other intra-abdominal condition requires surgical treatment.

*Group 2*—Failures in those cases in which there were real indications for the gastro-enterostomy but in which the results of the operation were unsatisfactory were chiefly due to (1) imperfect functioning due to a defect in the anastomosis itself or the location of it, (2) an overlooked intra-abdominal disease, and (3) a recurring ulcer.

The first cause produces what may be designated a malfunctioning anastomosis. It is difficult to determine what cases should be placed in this group, since in all those cases of recurring ulceration, particularly at the point of anastomosis it is uncertain whether malfunction was responsible. Without ulceration at this point malfunction is extremely rare. For example, in 7000 cases of gastro-enterostomy for peptic ulcer in the Mayo Clinic it was found necessary to disconnect the anastomosis in only five cases because of malfunction alone. The reason for the rarity of the malfunction (excluding the unnecessary gastro-enterostomy) is that proper performance of the operation on adequate indications gives satisfactory relief of ulcer symptoms in 90 per cent of the cases, and in the majority of the remainder the symptoms are mild, of short duration and easily controlled by simple measures since they are usually the result of dietary indiscretions or careless habits of living. It becomes necessary to disconnect the anastomosis in cases of malfunction only when the symptoms are not relieved by the gastro-enterostomy and new symptoms have developed as a direct result of this malfunction. The latter is generally due to some technical defect in the performance of the operation or judgment in selecting the type of operation.

The important points in the technic of gastro-enterostomy have been so frequently described that it is only necessary to emphasize the fact that by far the most common cause of the occasional disappointing results from gastro-enterostomy is inadequate drainage. This may be due to the site chosen for the anastomosis if it is too near the lesser curvature of the

stomach, too close to the pylorus, or so distant from the pylorus as to create, in a large stomach, an atonic segment between anastomosis and pylorus, resulting in gastric retention. Such cases have been met with. Or, the opening may be too small, either because it was made so at operation or because of contraction due to poor functioning and disuse. The proximal loop of the jejunum may be too long, leading to retention of its contents and regurgitation of bile, or it may be so short as to rotate the anastomosis with sufficient kinking of one or both loops to interfere with gastric motility or drainage. Extensive raw surfaces following the division of adhesions between the first portion of the jejunum and mesocolon may be responsible for later malfunction due to bands of adhesions deforming one or the other of the loops.

Although there seemed to be real indications for gastro-enterostomy in this group, the result may have been unsatisfactory because some other type of operation would have been preferable. There is, however, little evidence in this series to show that, when the anastomosis was functioning properly and there was no recurrence of ulceration, any other type of operation would have been more effective in controlling the symptoms. It is not within the compass of this paper to discuss all the facts relative to this point. It should be repeated, however, that in gastric ulcer, gastro-enterostomy alone should not be depended on to relieve symptoms permanently, or to prevent subsequent complications, but that radical removal of the ulcer, either by excision or by partial gastrectomy, may be the method of choice. For the uncomplicated duodenal ulcer, there is as yet no definite evidence that any other type of operation, in the great majority of cases, gives better end-results than gastro-enterostomy. Partial gastrectomy for chronic duodenal ulcer is comparatively simple and safe, but the end-results cannot as yet be foretold, and an attempt to establish such a radical procedure for such a small and benign lesion may well be postponed until more proof is available that it is warranted. The very great advantages of gastro-enterostomy over these radical procedures are that it is not a mutilating operation and that by disconnecting the anastomosis the gastro-intestinal tract can be restored to normal. It may be that partial gastrectomy would have been preferable to gastro-enterostomy in the small number of cases in which the latter operation failed to relieve the symptoms completely but there is no way of selecting such cases. For the bleeding type of duodenal ulcer excision of the ulcer and gastro-enterostomy or gastroduodenostomy are, of course, preferable to gastro-enterostomy alone.

A secondary operation is indicated in this group when it can be shown that the anastomosis is not functioning properly, or when it is inadequate to control symptoms satisfactorily and permit complete and permanent healing of the original lesion. If the patient has not already done so, he should be advised to follow a most careful dietary regimen long enough to determine whether it will cause sufficient amelioration of symptoms to obviate further surgical intervention.

When there are recurrence and persistence of symptoms, they may be due to disease elsewhere in the abdomen, so that the importance of a painstaking

and routine exploration cannot be too often or too strongly emphasized. The fact that a chronic duodenal ulcer has been found does not imply that there may not also be a gastric ulcer, a diseased gall-bladder, a large spleen, or intestinal or pelvic disease, any one of which may explain the failure of the gastro-enterostomy to relieve all symptoms.

The final and most important cause of failure of the gastro-enterostomy in this group of cases is the reactivation of the original ulcer or the occurrence of a new ulcer in the stoma, stomach, duodenum, or jejunum. The total percentage of such recurrences is under 5 per cent. When such a recurrence is intractable to medical management, secondary operation is advisable. Stomatal ulcers occur in about 2 per cent of cases after operation for peptic ulcer. In the Mayo Clinic, ulcer at or near the anastomosis has developed in 1.44 per cent of the cases following gastro-enterostomy for chronic peptic ulcer (1.37 per cent following gastro-enterostomy for duodenal ulcer, and 0.07 per cent following gastro-enterostomy for gastric ulcer).

The cause of stomatal ulcers is still an enigma since control of all the factors supposed to be involved in the production of ulcer does not prevent them entirely. Since only about 2 per cent of patients with ulcer develop such secondary ulcerations, it can only be concluded that such patients are abnormally susceptible to ulcers, and that the cause of the original ulcer still exists. As will be pointed out later, they require radical surgical measures. Recurrence of ulcer can be kept at a minimum by a carefully performed operation, the subsequent eradication of all foci of infection, and the avoidance of gross indiscretions in diet or habits of living.

The symptoms of recurring ulcer are like those of the original ulcer, except that those in the stoma have certain characteristic features. The most important of these is the severity of the pain associated with the taking of food, its location to the left of the median line and at a considerably lower level than with ulcer of the stomach or duodenum. The stomatal ulcer is more resistant to treatment and the temporary relief which often follows medical treatment of primary ulcer is not often obtained. When such relief is experienced, the prompt reappearance of pain on return to a normal diet is of marked diagnostic significance. The stomatal ulcer shows a marked tendency to penetrate into neighboring structures so that colic fistulas are not uncommon in long-standing cases. The incidence of hemorrhage is higher in cases of gastrojejunal ulcer than in cases of primary ulcer.

Operation is indicated for the recurring ulcer more often than for the original ulcer. It offers the best and safest prospect of cure. A thorough trial with an approved medical regimen may first be carried out but it is even less likely to succeed than with the original ulcer and should therefore not be prolonged.

*Technic*—The essential feature in operating for any type of recurring ulcer is a careful and routine abdominal exploration. This should be done in every case unless conditions prohibit it. The exploration will include mobilization and inspection of the anastomosis, examination of the stomach, the

duodenum, and particularly of the pylorus to determine whether it can be depended on to function satisfactorily, and also examination of the gall-bladder, pancreas appendix, spleen, and pelvis, since disease in some organ other than the stomach or duodenum may at least partly, explain the original symptoms. The exploration will enable the surgeon to decide what surgical procedure is necessary. The more common of these are (1) disconnection of the anastomosis followed by pyloroplasty or some type of gastroduodenostomy, (2) disconnection of the anastomosis alone, (3) disconnection of the anastomosis with cholecystectomy or appendectomy or both, (4) disconnection of the anastomosis followed by a second gastro-enterostomy, and (5) disconnection of the anastomosis followed by partial gastrectomy.

These different procedures vary from those of comparative simplicity to those of extreme difficulty. Disconnection of an uncomplicated anastomosis is performed as follows: the incision is preferably placed to the left of the former incision or incisions (in this series 35 per cent of the patients had been operated on more than once). The stomach, colon, omentum, and pylorus are first freed and the anastomosis mobilized. The most important step is freeing the mesocolon which is usually intimately attached at the anastomosis. The safest and simplest method of freeing this is to begin the dissection on the posterior aspect of the stomach and when the posterior wall of the stomach is exposed to insert the finger between the mesocolon and the stomach, by finger dissection to loosen the mesocolon from the stomach, and with the finger as a guide to dissect it free from its attachments. The segment of stomach to which the intestine is attached can then be drawn down through the large opening in the mesocolon, a gauze pad placed behind the anastomosis, and straight rubber-covered clamps placed on this segment of stomach and on the two limbs of the jejunal loop, each clamp being about 8-10 cm. from the anastomosis. While a finger supports and identifies the line of anastomosis posteriorly, heavy scissors are used to divide the anastomosis, the line of division being slightly on the stomach side. The opening in the jejunum is then closed in a transverse direction by two rows of continuous chromic catgut reinforced by interrupted sutures of the same material. Encroachment on the lumen of the jejunum is not dangerous if the opening is closed in this transverse direction. The opening in the stomach is closed by continuous chromic gut, and the defect in the mesocolon repaired by a continuous fine catgut suture.

While such an operation is usually relatively simple and safe, disconnection of the anastomosis in a complicated case in which resection of the stomach is also necessary is always prolonged, often difficult and the patient is frequently in poor condition. The most serious surgical problem is the gastrojejunal ulcer which has perforated into the colon, particularly when the anastomosis has been made on a very short proximal loop, and when the pylorus because of previous operation or scarring from ulceration, cannot be depended on to carry on its function normally. In such cases a number of major surgical procedures may be necessary. Disconnection of the anas-

tomosis is difficult because the extensive inflammatory products have fixed the anastomosis and do not permit ready mobilization. The colon should first be dissected free, the opening closed, and the site of the closure covered with omentum. I have found it advisable, in disconnecting the anastomosis in which ulceration has occurred, first to divide the stomach on a line about 2.5 cm. or more from the anastomosis. This permits inspection of the anastomosis and a more precise excision of the ulcer. Before the jejunum is closed, the edges of the stomach still attached to the jejunum are removed. If it has not been possible to ascertain the patency of the pylorus, it may be examined digitally through the opening in the stomach. If a resection of the stomach is indicated (and it is the operation of choice in recurring ulcer, whatever its situation), the opening in the stomach is closed with a running suture of chromic catgut. This prevents soiling. The pyloric end of the stomach is then mobilized and, if the duodenum is scarred by previous ulceration or operation, the division, between crushing clamps, is made far enough above the pylorus to permit of an easy and safe closure of the stump. The omental attachments along the lesser and greater curves are divided to a point high enough on the stomach to minimize the possibility of subsequent ulceration. All vessels are tied, a rubber-covered clamp is placed, with the least possible pressure, on the stomach about 3.75 cm. above the line of resection, and the stomach turned to the left. The jejunum is then brought up in front of the colon and approximated to the stomach so that the proximal jejunum, about 3.5 cm. from the duodenojejunal angle is at the lesser curve. An antecolic anastomosis is often preferable in such cases because the resection is extensive and a retrocolic anastomosis must be made in a field of adhesions, with the danger of subsequent adhesions crippling the anastomosis. The first row of chromic catgut is placed before the stomach is cut away, and the anastomosis completed in the usual manner. A small entero-anastomosis should be added to this type of anastomosis, the union being made at a level with the duodenojejunal angle. The segment of stomach, the entire anastomosis, and the entero-anastomosis will fall well to the left of the median line and perfect drainage is secured with no danger of retrograde distention of the proximal loop. In certain cases, if the closure of the pyloric stump has not been satisfactory or if it is desirable to keep the entire field of operation as immobile as possible, a catheter may be sutured into the distal loop of the jejunum for a week or ten days for feeding purposes. Similarly when the closure of the transverse colon has been difficult and perhaps imperfect, a small cecostomy may be made to prevent distention of the colon. Such an operation is of course formidable but if the pre-operative and post-operative management is all that it should be and the operation properly performed the results will be excellent.

Patients with secondary ulcers should first be placed in the hospital under the care of the clinician. Hospitalization enables the clinician to acquire a better understanding of the surgical problems involved in the more complicated cases and more important enables him to estimate the hazards of opera-



tion and thereby to bring the patient to the point where operation can be carried out with the maximal safety. Such preparation consists chiefly of transfusions, gastric lavage, the administration of sodium chloride and glucose solutions, a bland diet, and the control of the toxæmia associated with obstruction. The latter is a most striking advance in the management of obstruction, and the value of McVicar's recent report on this management in thirty such cases can hardly be over-emphasized from a surgical point of view. When the responsibility of the preparation of patients with serious gastric disorders is really assumed by the gastro-enterologist not only with regard to the medical aspects of the case, but the results of the operation, it immeasurably raises the factor of safety and adds to the prospect of good post-operative results. Such cooperation made possible the report of a recent series of eighty partial gastrectomies (including thirty-six for cancer, nine for gastro-jejunal ulcer, and twenty-eight for gastric ulcer) with but one death.<sup>1</sup>

The problems of gastro-enterostomy, therefore, should be limited, at least before the American Surgical Association, to those cases in which the operation was clearly indicated, but failed to afford permanent relief from the symptoms. Fortunately such cases are not common, and it is equally fortunate that the simple mechanical principles on which the operation is based permit the restoration of the stomach and upper intestinal tract to the condition existing before the gastro-enterostomy was performed. A recent writer of the European school of radical gastric surgery claims that gastro-enterostomy is a disease. If it is a disease, it at least has the virtues of being both preventable and curable.

## REFERENCE

- <sup>1</sup> Balfour, D. C. The Value of Cooperation between Internist and Surgeon in the Management of Complicated Gastric Conditions, with some remarks on Partial Gastrectomy. *Jour Am Med Assn*, 1925, vol 14441, pp 876-879.

# PRIMARY CARCINOMA OF THE SMALL INTESTINE IN AN OCTOGENARIAN<sup>\*</sup>

BY ALEXANDER PRIMROSE, C B , M B , C M

OF TORONTO, ONTARIO

PROFESSOR OF CLINICAL SURGERY IN THE UNIVERSITY OF TORONTO

TUMORS of the small bowel may be innocent or malignant. The innocent tumors met with include adenoma, fibroma, lipoma, and myoma. The malignant growths are cancer and sarcoma, both of which are rare manifestations in the small intestine. It is interesting to observe that sarcoma when it does manifest itself in the intestine is much more common in the small bowel than in the large. Thus Corner and Fairbank collected from the literature 103 cases of sarcoma of the intestine, of these 65 (63 per cent) were present in the small bowel, the largest number being in the ileum, and 38 in the large bowel (37 per cent). The reverse is true of cancer. Only three per cent of carcinomata of the intestines occurs in the small bowel (Ewing, Johnston, Hinz).

The age incidence for sarcoma of the small intestine shows the greatest frequency between thirty and forty years of age (Corner and Fairbank), while the average age for cancer in this locality is forty-six and one-half years (Ewing). On the other hand, Telling reports a spindle-cell sarcoma in a child three and one-half years old and Duncan records a scirrhous cancer at the same age (three and one-half years). As far as I am aware, primary carcinoma of the small intestine has not hitherto been recorded in an octogenarian.

THE CASE is as follows. B. R., *et* eighty, male, was seen in consultation January 14, 1924. Ten days previously he had celebrated his eightieth birthday. For some months he had experienced increasing difficulty in getting a movement of the bowels. He suffered abdominal pain and there was some distention. A barium enema followed by X-ray examination revealed a diverticulitis of the sigmoid flexure of the colon; there was a marked degree of constriction of the lumen with some diverticuli in the picture. There was however, no very great degree of obstruction at this point. The writer had removed this patient's prostate five years previously and he had some cystitis. This fact, in addition to his extreme age caused us to temporize recognizing the conditions as constituting a bad risk for operation. One element in his favor was the circumstance that he was a man of remarkably good physique and had enjoyed excellent health for many years.

February 27, 1924 obstruction became more pronounced with increased pain and vomiting. He had lost weight. Operation had become imperative. The abdomen was opened under gas anesthesia when one was surprised to find the small bowel distended while the large bowel was of normal size and appearance. The distended loops of small bowel were allowed to protrude freely from a large abdominal incision with the minimum amount of traumatism. A constriction at once became evident in the ileum eight inches proximal to the ileo-caecal junction. A tumor was felt at this point and the wall of the bowel above in its immediate neighborhood was thickened as was also the adjacent

---

<sup>\*</sup> Read before the American Surgical Association May 4, 1925.

mesentery There was no visible or palpable lymph glandular involvement Without disturbing the protruded coils of intestine an immediate resection was performed including the thickened portion of bowel above the tumor, and an end-to-end anastomosis established The intestine was then replaced with great care within the abdomen and the incision closed without drainage The patient made an uninterrupted recovery and now in his eighty-second year is completely free from his former trouble

*The pathologist's report*, by Dr W L Robinson, is as follows Gross Specimen (Fig 1) consists of a piece of bowel 8 cm in length and about 4 cm in diameter Attached to this is a bit of the mesentery, no longitudinal stricture can be seen On opening the gut at about the central portion projecting into the lumen is seen a tumor mass about 2 cm in diameter It is pinkish-white in color, fairly firm in consistency, and does not protrude far into the gut lumen At its base is some white scar tissue and the gut seems to be contracted by fibrous tissue at this point On section this tumor mass is yellowish-white in color and homogeneous in appearance and fairly soft throughout

*Microscopic Findings*—(Figs 2 and 3) Section of this tumor mass shows it to be composed of cords and masses of atypical epithelial cells which are growing in the bowel wall and invading deeply through the muscular coat These epithelial cells are all of about the same size and shape They have a round somewhat reticulated nucleus and a moderate amount of pinkish staining cytoplasm and in various places is seen a somewhat pseudo-glandular arrangement No mitotic figures are present The cells are supported in a fibrous tissue stroma which in places is quite considerable in amount Obviously it is a tumor which is only locally malignant

Section taken from the gut higher up shows the mucous coat to be considerably degenerated and throughout there is a moderate amount of fibrous tissue infiltrated with many polymorphonuclear cells and lymphocytes The muscular coat seems somewhat thickened and its fibrous tissue is increased in amount In the subserous coat fibrous tissue proliferation is marked and here in various places are seen focal aggregations of lymphocytes

The pathological diagnosis was that of embryoma ('benign carcinoma' of the intestine) with acute and chronic enteritis

The development of cancer in the small intestine would seem, in many instances to bear a direct relationship to the development of intestinal polyp and may even be a local malignant manifestation in a general polyposis On the other hand, adeno-carcinoma may arise in the small bowel quite apart from the development of polyp, such tumors may be slow in growth but eventually they tend to ulcerate and to develop scirrhous structure They metastasize in the mesenteric glands, the liver the lungs and elsewhere

The type of tumor found in the present instance was only locally malignant It belongs to the group which has been variously described as "carcinoid," "embryoma" and "basal-cell carcinoma" These tumors are frequently multiple they usually form more or less spherical masses projecting from a wide base into the lumen of the bowel The surface is smooth and covered with mucosa They invade the muscularis and subserous tissues They do not tend to ulcerate but may be accompanied by a scirrhous formation which is capable of producing a ring stricture of the bowel The dilated bowel above usually shows hypertrophy of the muscular coat with fibrosis These conditions were present in the case reported in this paper In a case reported by Judd the entire small intestine proximal to a growth in the ileum was enormously distended, very thick walled, injected and oedematous

An attempt has been made by Johnston to collate the clinical phenomena

produced by such a tumor causing obstruction in the small intestine. Visible peristalsis is commonly present indicating definite evidence of mechanical obstruction, and when the stricture exists in the lower part of the ileum, four or five coils of distended bowel will produce a "ladder" arrangement as they lie, side by side, running transversely across the abdomen. Shifting dulness is exhibited as the position of the patient is changed, due to the fluid content of the distended bowel above the obstruction. The symptoms include pain, vomiting and often rapid emaciation. There is frequently much "gurgling" noted both by the patient and the doctor. Blood in the stools is rarely met with, but is said to be most common in the stenosing form. The existence of a tumor is rarely discovered on examining the patient. Lahey, however, reports two cases in each of which was a palpable freely movable tumor. Hinz has also reported two such palpable tumors. When the tumor exists in the jejunum the clinical picture has often simulated pyloric obstruction leading to an erroneous diagnosis of a lesion in the stomach or duodenum.

Having regard to the nature of this growth—a smooth rounded, slow-growing tumor projecting into the lumen—one is not surprised to find that intussusception has been produced in many of the reported cases. In the more malignant



FIG. 1.—Primary carcinoma small intestine (Ileum)

type of adeno-carcinoma perforation may occur and a fistulous communication may be established between neighboring coils of intestine. Johnston refers to water color drawings of three cases of carcinoma of the jejunum made by Sir Robert Carswell in Paris, between 1821–1831. In all of these perforation had occurred. One of them shows a fistulous communication between the jejunum at the seat of growth and the transverse colon.

The carcinoid or embryonal tumors occurring in the small bowel, form an interesting group of new growths which were first described, as specific entities in 1888 by Lubarsch. The histological findings in all cases are sufficiently distinctive. The cells are spherical or polygonal in shape and are massed together with a considerable amount of interstitial fibrous tissue surrounding the cell groups. There may be some traces of alveolar formation. Many writers believe these tumors are similar in character to the

growths which are described as "primary carcinoma of the appendix" (Aschoff, Adami and McCrae, etc.) Not only is this true of the histological structure, but the gross appearances are very similar. Thus in the case described in this paper the writer at the time of operation remarked on the fact that the tumor, with its smooth surface and firm consistence, resembled the gross appearance of growths of the same type met with in the appendix. Bunting observed the close resemblance of these tumors to the basal-cell epitheliomata which have been carefully studied by Krompecher, multiple tumors occurring chiefly in the scalp, which do not tend to metastasize and which have been considered as arising from the hair follicles or sebaceous

glands. Ewing has discussed the views which have been promulgated as to the origin of these tumors suggesting that they may represent heterotopic intestinal mucosa, heterotopic Brunner's glands or heterotopic pancreatic gland tissue. The cells may exactly reproduce the islands of Langerhans of the pancreas.

These tumors run a benign course. They grow slowly and seldom ulcerate on the surface, they do not tend to form metastases and do not

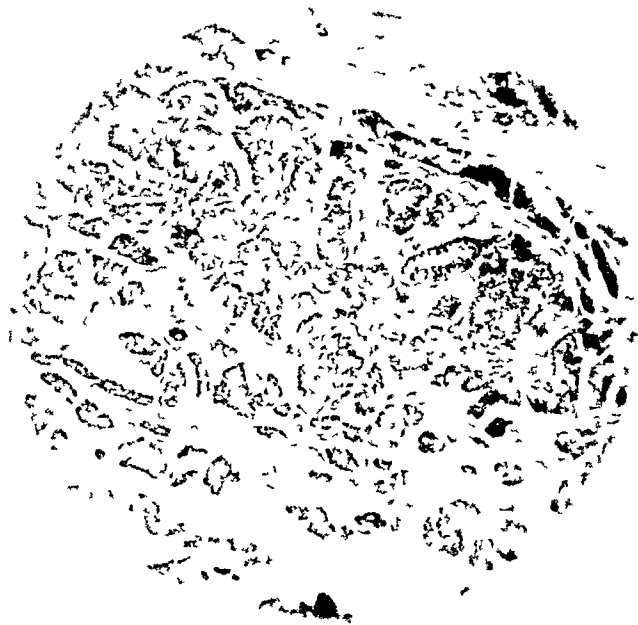


FIG. 2.—Microscopic findings in the tumor described in the text (X 250)

recur after removal. The only exception one had found in the literature is a case recorded by Ransom. A woman fifty years of age had a rounded polypoid growth projecting into the lumen of the ileum six inches from the ileo-cæcal valve. She had numerous metastases in the liver. The histology of this growth, which is described in detail and figured in its microscopic structure in Ransom's paper, would appear to be identical with the tumors described by Bunting, Lubarsch and others. The occurrence of metastasis therefore must be considered as a very remote possibility.

The carcinoid tumors (often multiple) of the small bowel would appear to be analogous with the so-called primary carcinoma of the appendix. The clinical course and the histological picture would seem to establish this fact. In a paper which the writer published a few years ago, attention was called to the somewhat remarkable co-existence of tubercle and the growths in question in recorded cases. In that paper one described two cases of primary carcinoma of the appendix in sisters both of whom suffered from tuberculosis.

the one from pulmonary tuberculosis, the other had a primary cancer of the appendix adherent to a tuberculous fallopian tube. This relationship to tuberculosis is not only true of the appendix tumor, but is found as a common event in the recorded cases of the multiple tumors of the small intestine. Curiously enough the gross appearances often simulate tubercle. Thus Venot and Parcelier refer to two cases in the literature reported by Tixier and Wrede, respectively, in which tumors of the small bowel were regarded as carcinoma at operation but which proved by microscopic examination to be tuberculous. In a third case reported by Chahier the reverse was true: multiple tumors in the small bowel (and in addition one in the cæcum and another in the transverse colon) were believed to be tuberculous both at operation and at autopsy, but subsequently the histological structure proved to be colloid cancer. Lubarsch suggests that tuberculous infection, even as a local trauma may lead to the development of cancer. Hinz reports two cases of carcinoma of the small bowel accompanied by tuberculosis. Milner in investigating fourteen cases of primary cancer of the appendix is struck

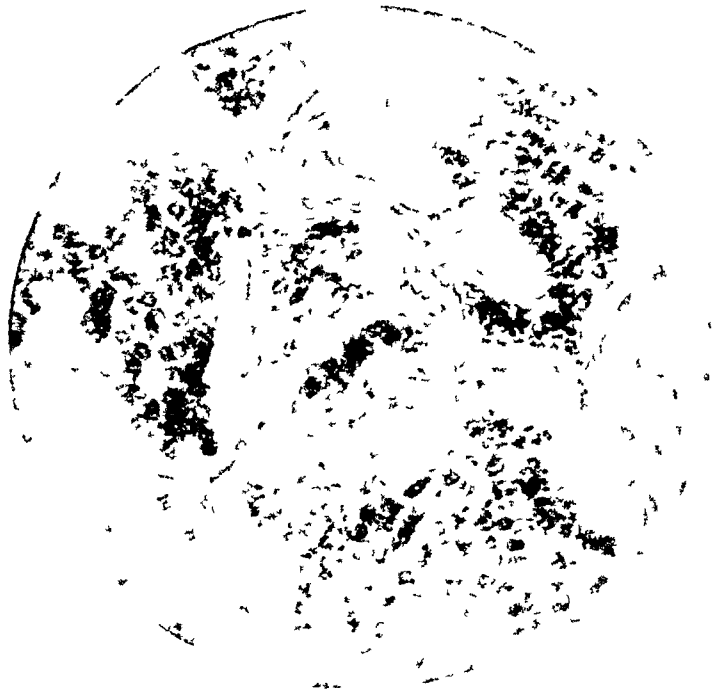


FIG. 3.—Microscopic findings in the tumor described in the text (X 400.)

by the resemblance to tuberculous cases and concludes that the tumors are the product of a chronic hyperplastic inflammation, chiefly a hyperplastic lymphangitis, and their parenchymal cells are endothelium and not epithelium. Then there is the significant case reported by Balfour and Watson of tuberculosis of the Fallopian tube in which the extreme ends, which were free from tubercle, showed marked hyperplasia of the epithelium with extension into the muscular wall, presenting a histological picture of carcinoma. Oberndorfer (quoted by Bunting) found four nodules in the middle of the ileum of a woman who died of chronic tuberculosis. "The nodules showed a rather fibrous stroma and alveoli filled with polymorphous cells, but as the author could find no definite connection with the intestinal epithelium he regarded the tumors as lymphatic endothelial carcinomata."

The relationship of tuberculosis to cancer has frequently been the subject of speculative enquiry. Rokitsansky many years ago (1826) considered there

was an antagonism between tuberculosis and cancer. In support of his theory he noted the fact that in organs where tuberculosis commonly occurred, cancer was rarely found and *vice versa*. Thus in the lungs tubercle is common and cancer rare; in the stomach cancer is of frequent occurrence and tubercle seldom found, and so he contrasts the occurrence of these diseases in the ovary, the salivary glands, the œsophagus, the rectum and the ileum. In each of these organs one or other disease is common and the other rare. In 1915, Shattock and Dudgeon confuted this theory. They recognize that while the co-existence of tuberculosis and carcinoma is not a common one, yet the two diseases may be present simultaneously in different organs or they may co-exist in the same organ. They refer to a specimen in the Royal College of Surgeons Museum in which metastatic carcinoma occurred in lungs which were tuberculous. In their paper they reproduce a drawing showing the microscopic section of a tuberculosis of the testis distributed in a spheroidal-cell carcinomatous growth. They quote Roger Williams as having collected from the literature instances in which the two diseases were present in the same locality. This list includes the stomach, uterus, mamma, liver, large intestine, rectum, small intestine, larynx, lung and œsophagus. Nevertheless the rarity of this conjunction of the two diseases is shown by Roger Williams, who in 136 cancer necropsies found only two cases in which both diseases existed together. Oertel who discusses this subject at length concludes that the two diseases do not possess specific antagonistic qualities.

While tuberculosis is seldom associated with malignant forms of cancer, it would appear to be a much more frequent accompaniment of the so-called carcinoid tumor of the small bowel and of the appendix. The genesis of this interesting tumor is still obscure. From a study of the cases in literature the author is inclined to believe that the simultaneous existence of tubercle and the carcinoid tumor is more than a mere coincidence and that possibly tuberculosis may in many instances, at any rate, play an important part in the production of the tumor formation.

#### BIBLIOGRAPHY

- Adam and McCrae. A Text-book of Pathology, 1914, p. 658.  
 Aschoff, L. Pathologische Anatomie, 1911, Bd. II, p. 708.  
 Barbour, A. H. F., and Watson, B. P. Tuberculous Pyosalpinx. Journal of Obstetrics and Gynæcology of the British Empire, September, 1911.  
 Bunting, C. H. Multiple Primary Carcinoma of the Ileum. Johns Hopkins Hospital Bulletin, vol. xv, 1904, p. 389.  
 Corner, E. M., and Fairbank, H. A. T. Sarcomata of the Alimentary Canal. Transactions Pathological Society, vol. lvi, 1905, p. 20.  
 Duncan, A. J. Scirrhus of Abdominal Organs in a Young Child. Edinburgh Medical Journal, vol. xxxi, 1886, p. 1127.  
 Ewing, James. Neoplastic Diseases, 1919, p. 641.  
 Hinz, R. Ueber den primären Dunndarmkrebs. Archiv für Klinische Chirurgie, vol. xcix, 1912, p. 305.  
 Johnson, Raymond. Carcinoma of the Jejunum and Ileum. British Journal of Surgery, vol. ix, 1922, p. 422.

## PRIMARY CARCINOMA OF THE SMALL INTESTINE

- Judd, E S    Carcinoma of the Small Intestine    Collected Papers of the Mayo Clinic  
vol x, 1918, p 203
- Krompecher, E    Ueber die Basalzellentumoren der Zylinderepithelschleimhaute mit  
besonderer Berücksichtigung der "Karzinoide" des Darms    Ziegler's Beiträge Z  
path Anatomie, vol lxxv, 1919, p 79
- Lahey, F H    Carcinoma of the Small Intestine    ANNALS OF SURGERY, vol lxxii, 1915,  
p 428
- Lubarsch, Otto    Ueber den primären Krebs des Ileum nebst Bemerkungen über das  
gleichzeitige Vorkommen von Krebs und Tuberculose    Virchow's Archiv, 1888  
Bd cxi, S 281
- Milner, R    Die Entzündlichen Pseudo-Kerzinome des Wurmfortsatzes    Deutsche  
medizinische Wochenschrift, No 25, 1910, vol xxxvi, p 1191
- Oertel, H    On the Relative Local Influence of Co-existing Tuberculous Inflammation  
and Cancer in the Lung    Journal of Medical Research, Boston, vol xxxv, 1911-12,  
p 503
- Ransom, W B    Primary Carcinoma of the Ileum    Lancet, 1890, vol ii, p 1020
- Rokitansky Carl    Pathological Anatomy    English Edition, vol i, p 237
- Shattock, S G, and Dudgeon, L S    Wound Inoculation in Carcinoma    Trans Royal  
Society of Medicine, vol viii, Pt 3, 1915, p 33
- Telling, W M    Primary Sarcoma of Small Intestine Causing Unusual Symptoms  
Trans Royal Society of Medicine, vol xiii, 1919, p 152
- Venot et Parclier    La Carcinome primitif du jejuno-ileon    Revue de Chirurgie, vol  
xlvi, 1913, p 678, vol xlviii, 1913, p 436



# INTUSSUSCEPTION IN ADULTS DUE TO THE INVAGINATION OF A MECKEL'S DIVERTICULUM

By WILLIAM E. LOWER, M.D.

OF CLEVELAND, OHIO

FROM THE CLEVELAND CLINIC

THE interest which is always attached to pathological conditions which originate in a Meckel's diverticulum, together with the comparatively rare occurrence of an enteric intussusception due to invagination of this anomalous structure, has led me to report the following two cases which have occurred in my own surgical practice, one many years ago and the second within the current year.

CASE I.—The first of these patients was a man, forty-three years of age, who for a year had had attacks of pain in the upper abdomen with some vomiting which were thought to be due to indigestion. These attacks had been of moderate severity until ten days before I saw him in consultation, when he had a severe attack of pain and vomiting with some abdominal distention. This attack lasted from two to three hours, the severe pain continuing throughout that period. As soon as the attack passed however, the patient went back to work. Two days later vomiting began again and lasted for three hours. Five days later another attack somewhat less severe than the preceding, lasted for four hours, and again five days later the final attack occurred which was so severe that the patient had to be carried home and a physician called. Severe pain lasting for two hours. Examination revealed that there was some distention and an indefinite mass in the right upper abdomen. There was not much rigidity and only a slight elevation of temperature. The attacks simulated hepatic colic but the fullness in the right side was not like that which would be caused by a distended gall-bladder. An exploratory operation was advised, the abdomen was opened by a right rectus incision which disclosed an ileocecal intussusception about one and one-half feet in length, about four feet of the intestine being involved. It was impossible to reduce the intussusception completely by manipulation. It was therefore resected and an anastomosis of the ileum to the transverse colon was made. Dissection of the resected portion of the intestine showed that in addition to the ileocecal intussusception there was an enteric intussusception about six inches in length and that the cause of the intussusception was an inverted Meckel's diverticulum. The patient made a good recovery from the operation and has remained entirely well.

CASE II.—The second case was a woman, forty-four years of age who had had repeated attacks of colic for six months before I saw her. The attacks started in the epigastrium and radiated to the appendiceal region. The last attack began about a week before she entered the hospital. She never had any vomiting until the night before operation. The pain was more or less rhythmical spasmodic recurrences coming on about every five minutes. The patient was severely constipated and had considerable meteorism. The abdomen showed no rigidity, but was slightly distended and had a doughy consistency. There were no palpable masses and only moderate tenderness over the abdomen especially over the right kidney area.

Exploratory operation was performed and an enteric intussusception was found which could not be reduced. Resection was therefore performed with end-to-end anastomosis. The intussusception was approximately fifteen inches in length involving thirty inches of the intestines, which revealed an inverted Meckel's diverticulum.

## INTUSSUSCEPTION DUE TO MECKEL'S DIVERTICULUM

As far as I have been able to discover, only 52 clearly defined cases of intussusception due to an inverted Meckel's diverticulum have been reported in the literature. Hertzler and Gibson (1913)<sup>15</sup> collected 45 clearly defined cases with reports of six others which they consider doubtful. To this list should be added six others reported respectively by Fauntleroy,<sup>16</sup> Depisch,<sup>15</sup> Greenwood,<sup>20</sup> Johnson,<sup>19</sup> Hood,<sup>22</sup> and Vickers,<sup>2</sup> and a case reported by Stone,<sup>21</sup> which is of interest, as it probably illustrates the initiation of the process which, if it had continued, would undoubtedly have caused a complete



FIG. 1—*a* Gross specimen as removed. *b* Specimen opened showing inverted diverticulum.

invagination of the diverticulum with a resultant intussusception. "The walls of the diverticulum were oedematous, as it had been inverted much as a glove finger may be pushed in." A study of these reported cases brings out the following points which are of primary interest. As would be expected from the more frequent occurrence of Meckel's diverticulum in males, among these 52 cases, it is stated that 34 were in males and 9 in females, 11 were between 10 and 20 years of age, 21 under 10, the total range of age was from 7 months to 39 years, the average age being 13 years. My own cases, the more are older than any thus far reported. This point is of primary interest as it

indicates that in contradistinction to the usual incidence of intussusception, intussusception due to an inverted Meckel's diverticulum is in general a condition pertaining to older children or young adults and that it may be expected in more advanced years and there is no reason why it may not occur at any age

The points in the symptomatology which have impressed nearly all of the reporters are (1), the repeated attacks of partial obstruction before the culminating attack which led to surgical intervention, in some cases these repeated attacks being sufficiently mild and extending over a period of time to suggest chronicity, (2) the absence of blood in the stools, (3) the frequent lack of a palpable tumor, (4) the lack of local tenderness. All of these points are of prime importance in establishing the differential diagnosis between Meckel's diverticulum and conditions which might readily be confused therewith. As one would expect, the differentiation from appendicitis and from cholelithiasis is of primary importance.

Halstead<sup>4</sup> calls attention to what he considers to be a characteristic configuration of the abdomen, "that of an inverted cone, this being due to obstruction of the upper part of the intestinal tract. The absence of distention of the flanks is conspicuous during the early hours of the attack." Attention is called, also, to the coincident appearance in many cases of some abnormality of the umbilical scar. This, however, does not appear to me to be of any importance in the type of cases which we are considering here. When the remnant of the omphalomesenteric duct remains patent and attached to the umbilicus, intussusception through the umbilical opening may readily occur. Intussusception of this type, however, would occur most frequently in young children. If the diverticulum remains attached by a fibre or band to the umbilicus its invagination could hardly occur, although in such cases as will be noted later, inflammation of the mucous membrane and its opening might cause a partial inversion of its serous lining with a resultant intussusception. Excepting when the diverticulum is non-adherent to neighboring structures or is not attached to the umbilicus by bands or a fibrous cord this type of intussusception therefore, need not be considered, although in such cases other types of obstruction may readily occur such as volvulus or complete obstruction due to the catching or binding of the intestine about or under one of these attachments. I have had several such cases.

The manner in which the process of invagination of the diverticulum is initiated has been discussed by different writers, DeQuervain believes that it is due to a type of suction produced by the rapid passage of the contents of the small intestines past its opening whereby a partial vacuum is produced within the diverticulum. Apparently this view is shared by none of the other writers among whom the consensus of opinion seems to be that invagination is due either to peristalsis of the diverticular walls in an effort to expel its contents or, and this is by far the most frequently accepted opinion, to an inflammatory process about the opening of the diverticulum which produces thickening of its walls, this process gradually extending so that the mucous

## INTUSSUSCEPTION DUE TO MECKEL'S DIVERTICULUM

membrane at the opening is slowly pushed along with the peristaltic action and the contents of the intestine. Sometimes the inflammatory process may produce a polyp-like structure which increases the propulsive action whereby the serous lining of the diverticulum is pushed farther and farther into the intestinal stream. The process might be compared to a continued tugging on a partially attached silk or wool lining of a kid glove whereby at first the lining and finally the finger of the glove would become inverted. As the process continues the inverting diverticulum is projected farther and farther into the intestine and the resultant partial obstruction initiates the process of invagination of the intestinal wall itself. The apparent chronicity of this type of obstruction is well explained, as has been suggested by Corner," by the fact that since the obstructing process is unilateral, the stream would at first be only partially diverted diagonally rather than directly obstructed.

When one considers that, as is estimated, two per cent of all individuals have a Meckel's diverticulum, and that as a result of its proximity to the ileocaecal valve any hesitation of the faecal stream at that valve might easily cause particles of food to become lodged within it, the surprising fact would seem to be that there are not more catastrophes due to some pathological condition of this structure. We certainly should at least suspect the presence of a diverticulum and possibly of a beginning intussusception in cases which present the type of symptoms listed above, especially in young adults, or as is illustrated by my own cases, in older patients who have had recurrent attacks of right-sided abdominal distress, with or without bloody stools or diarrhoea, with or without a palpable tumor, with or without tenderness to the right of the umbilicus. In such a case if no other cause of the condition can be demonstrated, the presence of a Meckel's diverticulum should be suspected and an exploratory operation performed, for provided it is present the catastrophe of intussusception may occur at any time. If it is not present, no more harm is done by the exploratory operation than is done by the removal of the chronic appendix because of the presence of the train of symptoms which suggest a chronic appendicitis with the ever-present danger in that case also of an acute catastrophe. Moreover, just as the appendix is routinely removed in the course of an abdominal operation in order that the source of danger for the future may be obviated it would certainly appear well to consider whether or not one should look for a diverticulum in those cases in which an exploratory operation is performed for suspected appendicitis and the appendix is found to be normal.

The discovery of these rare conditions always brings a thrill to the surgeon. The thrill however is of no account unless it induces him to add his contribution to an interpretation of the significance of the condition. It is because of this that I have offered this note regarding this apparently unusual condition which nevertheless suggests an explanation of some of our most difficult cases—those which present vague uncertain symptoms which may be due to a large variety of causes as well as to some of the acute catastrophes.

especially in young adults While it is not advisable always to search for the unusual condition, nevertheless, the possibility of an unusual condition should always be borne in mind

# BIBLIOGRAPHY

- <sup>1</sup> Wallett, Edgar An Account of Some of the More Interesting Specimens Recently Added to the Museum St Bartholomews Hosp Rep, 1891, vol xxvii, pp 169-172
- <sup>2</sup> Adams, James Ileo-colic Intussusception Caused by an Inverted Meckel's Diverticulum Trans Path Soc, London, 1892, vol xliii, pp 75-76
- <sup>3</sup> Peters Invaginated Meckel's Diverticulum Rep of Tor Path Soc, Oct 30, 1897, Canadian Pract, 1897, vol xxii, pp 922-923
- <sup>4</sup> Kuttner, H Ileus durch Intussusception eines Meckel'schen Divertikels Beitrag z klin Chir, 1898, vol iii, pp 289-298
- <sup>5</sup> Erdmann, J F Report of a Case of Intussusception Due to a Meckel's Diverticulum N Y Med Jour, 1898, vol lxxii pp 526-528
- <sup>6</sup> McFarland, J Volvulus and Intussusception of Meckel's Diverticulum Phila Med Jour 1901 vol vii pp 863-864
- <sup>7</sup> Wainwright, J M Intussusception of Meckel's Diverticulum ANNALS OF SURGERY, 1902, vol xxxv, pp 32-35
- <sup>8</sup> Halstead, A E Intestinal Obstruction from Meckel's Diverticulum ANNALS OF SURGERY 1902 vol xv, pp 471-494
- <sup>9</sup> Corner, E M On the Pathology and Classification of Intussusceptions, with a Resume of Those Arising from the Appendix Ceci ANNALS OF SURGERY 1903, vol xxxviii, pp 690-725
- <sup>10</sup> Cheyne W Watson Intussusception of Meckel's Diverticulum ANNALS OF SURGERY, 1904, vol vi, pp 796-804
- <sup>11</sup> Bidwell, L A Intussusception Caused by an Inverted Meckel's Diverticulum, Excision and End-to-end Anastomosis Lancet, 1907 vol ii, pp 682-684
- <sup>12</sup> Gray, H Tyrell Some Cases in which Meckel's Diverticulum was Present Brit Med Jour, 1907, vol ii, pp 823-826
- <sup>13</sup> Gray, H Tyrell Invagination of Meckel's Diverticulum ANNALS OF SURGERY, 1908, vol xlvi pp 801-820
- <sup>14</sup> Drummond H Inversion of Meckel's Diverticulum ANNALS OF SURGERY, 1912, vol lv, pp 404-415
- <sup>15</sup> Hertzler A E and Gibson E T Invagination of Meckel's Diverticulum Associated with Intussusception Report of Cases with a Study of Recorded Cases Am J Med Sci, 1913, vol cxlvi, pp 364-386
- <sup>16</sup> Fauntleroy, A M Report of a Case of Intussusception Caused by a Meckel's Diverticulum U S Nav Med Bull, 1916 vol x, pp 511-513
- <sup>17</sup> McDonald, A L Meckel's Diverticulum as a Cause of Surgical Lesions Jour Lancet, 1918, vol xxxviii, pp 259-264
- <sup>18</sup> Depisch, F Ein Fall von Invagination eines Meckelschen Divertikels mit nachfolgender Duodardarminvagination Wien klin Wchnschr, 1921, vol xxxiv, pp 240-241
- <sup>19</sup> Johnson, J A Meckel's Diverticulum as an Etiological Factor in Intestinal Obstruction Report of Three Cases Minnesota Med, 1923, vol vi, pp 479-484
- <sup>20</sup> Greenwood, H H Ileo-colic Intussusception Caused by Meckel's Diverticulum and Simulating Ectopic Gestation Brit Med Jour, 1923, vol i, pp 1016-17
- <sup>21</sup> Stone, Eric Aberrant Gastric Mucosa Report of Two Cases An Umbilical Polyp and a Meckel's Diverticulum Surg, Gyn Obst, 1923, vol xxxvii, pp 51-56
- <sup>22</sup> Hood, U L Case of Intussusception Starting in Large Meckel's Diverticulum Lancet, 1923, vol i, p 1004
- <sup>23</sup> Vickers, W Intussusception with Meckel's Diverticulum M J Australia, 1923, vol i, pp 699-700

# ANATOMY AND TREATMENT OF REDUCIBLE OBLIQUE INGUINAL HERNIA<sup>1</sup>

BY ELLSWORTH ELIOT, JR., M.D.  
OF NEW YORK, N.Y.

THE unobliterated processus sacciformis which forms the sac of a congenital hernia almost invariably lies anterior or superficial to the structures of the cord. It is only in cases of long standing, when the sac is of large size, that the cord may lie along its inner side. Along the site previously occupied in foetal life by the processus sacciformis, an acquired inguinal hernia might naturally be expected to develop. Nature's obliteration of the processus sacciformis, however, is so complete that the resulting connective-tissue strand can rarely be identified and the process of repair is so effective that, in an acquired inguinal hernia the parietal peritoneum, finding a path of lesser resistance than that along the obliterated pouch, protrudes through the internal ring along the inner side of the cord and close to the outer side of the deep epigastric vessels. In a large number of incipient inguinal hernia, the writer has found this relation constant. Thus, in cases of unilateral bubonocoele in adults in which the frequency with which a hernia subsequently develops within a comparatively short time on the non-affected side has led the writer to advise simultaneous operation on both sides when the external abdominal ring of the non-affected side is lax and of increased dimensions on the supposedly non-affected side, even in the absence of the slightest expansile impulse, a small sac, extending only a fraction of an inch along the inner side of the cord is usually, although not always found. This relation of the sac to the cord is not mentioned in the usual text-book description of this subject which ordinarily states that while both epigastric vessels and cord lie to the outer side of the neck of the sac of a direct inguinal hernia the same structures lie to the inner side of the neck of the sac in the oblique variety. This latter relation unquestionably exists in herniae of large size and long standing, although in incipient cases and probably as long as the sac lies within the inguinal canal the neck of the sac lies to the inner side of the cord in both indirect and direct varieties. To account for the gradual change in relationship which may be described as a rotation of the sac around the cord, is difficult. That it actually takes place is well illustrated in a case observed by the writer in which the neck of the sac of an oblique inguinal hernia lying at first to the inner side of the cord came to lie a fraction of an inch below the internal ring anterior to it and a short distance lower down passed to its outer side in which relation it continued as it emerged through the external abdominal ring. It is not improbable in this instance that later observation would have disclosed the sac lying along the outer side of the cord throughout its entire extent.

---

\* Read before the American Surgical Association May 6, 1925.

Appreciation of this relation of the sac to the cord in incipient inguinal hernia facilitates the identification and treatment of the sac and thereby forestalls the possibility of its being overlooked with consequent failure to cure the patient. Not that a sac can invariably be demonstrated even though an expansile impulse has been observed over the internal abdominal ring. The writer has records of two such cases in which no sac was found, in one of which a dilated and tortuous varicocele, extending upward into the inguinal canal probably accounted by the overdilatation of the affected veins in the act of coughing for the expansile impulse simulating that of an ordinary hernia. The writer at least is convinced that the occasional absence of the sac is not due to the spontaneous reducibility of both sac and its contents, for the sac no matter how diminutive is always distinctly attached by delicate connective tissue to the adjacent cord from which however it can be readily separated by blunt dissection.

The deep epigastric vessels skirt the lower and inner portions of the circumference of the internal abdominal ring. While this constant relation is properly emphasized in all descriptions of hernia, the importance of the artery in contributing to the strength of this region is rarely if ever mentioned. It is well demonstrated in the so-called pantaloon type of hernia in which the peritoneum protrudes on either side of an unyielding vessel, and it is only in old and extremely large herniae that the vessels may eventually become displaced through the sheer weight of the hernial contents. Contributing as they unquestionably do to the strength of the inguinal canal, the writer believes that the intentional division of these vessels in the treatment of the sac of a pantaloon hernia favors a recurrence and should never be done. In these rather unusual cases, the neck of each sac should be ligated separately, leaving the intervening vessels intact or if possible the smaller sac should be drawn down in the larger leaving the vessels undisturbed.

No consideration of the anatomy of congenital hernia is complete without emphasizing its occasional association with undescended testis. In the most common type of this condition the testis lies within the inguinal canal behind the process sacciformis which extends well below the level of the external ring. In this condition in the writer's observation there has never been any obliteration or even narrowing in any part of the processus sacciformis, not even opposite the internal ring where in the normal descent of the testis occlusion is usually complete at the time of birth. That such occlusion may occur while the testis is still undescended is conceivable and several such instances have been observed by friends of the writer. It must, however be so rare as not to modify the fact that in every case of undescended testis the presence of the associated hernia alone justifies operation.

In the operative treatment of inguinal hernia the "Bassini" principle has won a well-deserved general recognition. At the same time its actual technic has undergone certain modifications. Of these, one advocated by the writer is designed to strengthen the region of the external abdominal ring—a region in which perhaps recurrence is most frequently observed. In the typical

Bassini operation the suture of the conjoined tendon to the shelving border invariably distorts the latter structure, especially in herniæ of large size, drawing it upward and inward. In fact it is rather an approximation of the shelving border to the tendon rather than of the tendon to the border, especially along the inner extremity of the suture line where, owing to its tendinous character the muscular arch is decidedly unyielding. To prevent this distortion as well as to strengthen the region of the external abdominal ring, the writer advocates the primary suture of the conjoined tendon to the spine

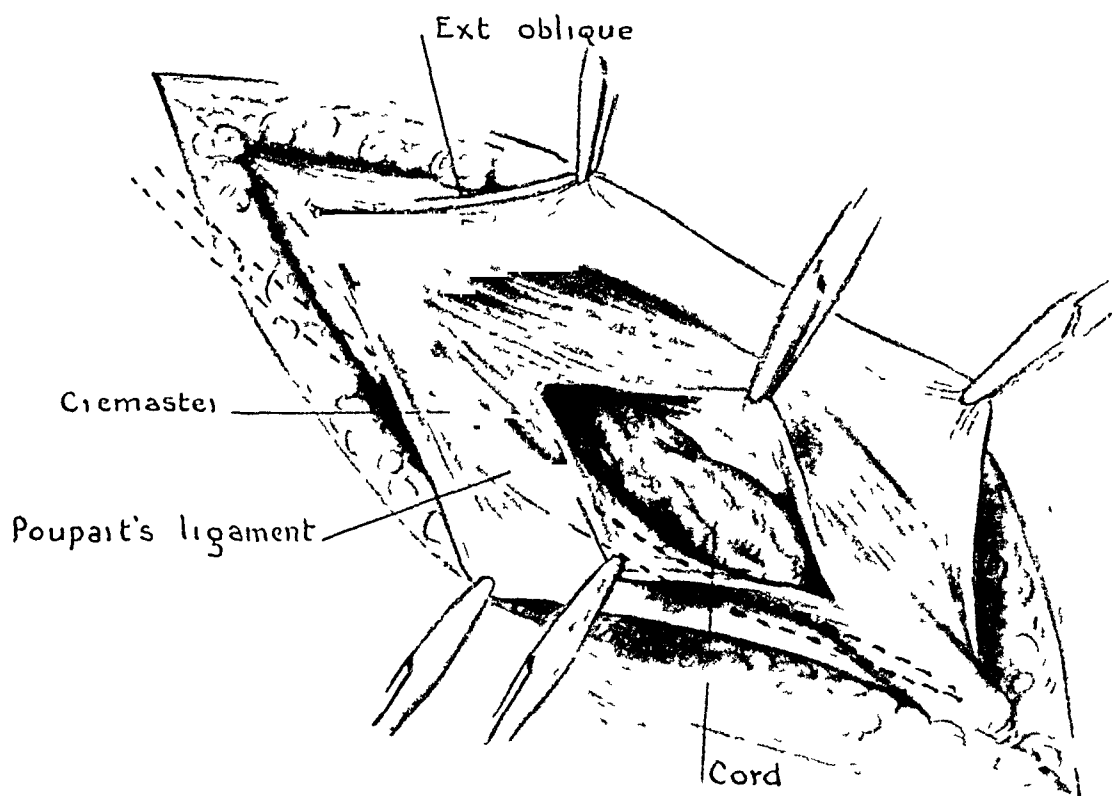


FIG. 1.—Stage I. Exposure of the cord through the divided cremaster.

of the pubis. With the suture in place the concave arching tendon is converted into a convex one with convex angle closely united to the spine; the inner short side rests against the chest of the pubis while the longer outer limb is in close proximity to the shelving border to which it is easily sutured without tension and without distortion. The suture to the spine requires a strong sharply curved needle which is passed beneath the periosteum as closely as possible to the compact bone. The external abdominal ring is further obliterated by the suture—also to the pubic spine—of its original upper and inner pillar so that when the suture is tightened that structure rests closely against the pubic crest. There are thus two strong unyielding structures, the conjoined tendon and the external oblique aponeurosis, reinforcing and obliterating the region of the original external abdominal ring. A new external ring is formed to the outer side of the pubic spine of sufficient size to permit the exit of the cord without undue constriction.



The second modification to which the writer has referred is designed to restore the normal dimensions of the inguinal canal, especially in complete herniæ, in which that canal may have been dilated to several times its normal size by the more or less constant presence of hernial contents. This is very satisfactorily affected by an overlapping of the divided external oblique aponeurosis, usually bringing the lower flap superficial to the upper, leaving only sufficient space for the adequate accommodation of the cord.

The writer wishes to emphasize the wisdom of the ligation of the sac at a level with the internal ring, just distal to the deep epigastric vessels. If the neck is of large size a running suture may be used as in the closure of any divided peritoneum. Ordinarily the neck of the sac well drawn down, is transfixed and ligated on either side. Other steps in the operation do not differ essentially from those generally employed and are fully demonstrated in the accompanying illustrations.

The writer opposed to the use of non-absorbable material, has used chromic gut sutures for many years—the heavier No “1” for the approximation of the conjoined tendon to the spine and fine No “0” for all other sutures. An early experience in which silkworm gut was used is responsible for this preference. In this instance, a typical “Bassini” for a reducible bubonocoele in an adult male, the patient developed and succumbed five weeks after operation to a rapid acute general military tuberculosis. Although the wound gave every indication of having healed primarily, examination revealed a small puddle of pus around each non-absorbable suture. It is quite possible that, in the patient’s condition of low vitality, a similar result might have followed the use of plain or chromic gut. The writer is convinced, however, that the approximation of the conjoined tendon to the shelving border may be effected without tension by a preliminary suture of that structure to the pubic spine as already described, and the danger of cutting through of the suture line with or without pus thereby averted.

Opinions differ as to which factor or factors the success of the Bassini operation is due. All seem to agree that a high ligation of the sac at the level of the internal ring is most important. Before the introduction of the Bassini operation, recurrence, after ligation of the sac at as high a point as possible without division of the external oblique aponeurosis, was usually a question of months even when the operation was followed by primary union.

The approximation of the conjoined tendon to the shelving border is considered by many a measure of considerable value. The fact that recurrence frequently appears near the inner extremity of the scar at a point where this approximation in the typical Bassini is least satisfactory and usually carried out under considerable tension, seems to justify the conclusion that approximation of these structures contributes materially to the strength of this part of the abdominal wall. In a paper published in the *Transactions of the Am Surg Assn* for 1923, Seelig seeks to prove by animal experimentation that union between muscle and fascial structures, even in the absence

## REDUCIBLE OBLIQUE INGUINAL HERNIA

of tension, does not occur and that shortly after the suture of the conjoined tendon to the shelving border the former structure resumes its original curved position. While any tension under which sutures are inserted may account for defective union, it is not generally maintained that, even in the absence of tension, a union at all comparable to that seen in the origin of the internal oblique and transversalis from their respective portions of Poupart's ligament

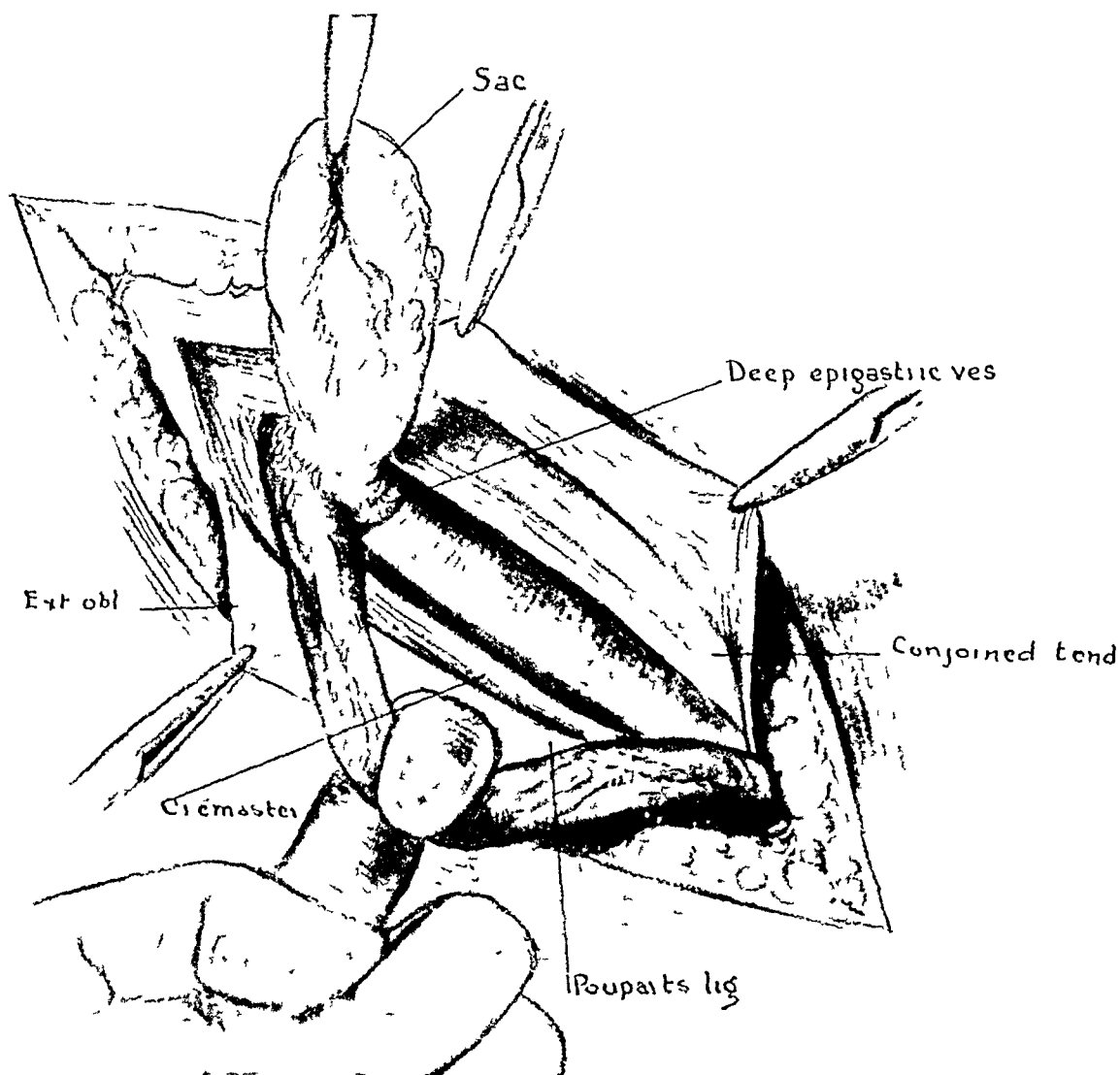


FIG. 2—Stage II. Separation of hernial sac from cord with its neck in contact with the deep epigastric vessels.

is to be expected. Even in so-called primary union opposed surfaces are ultimately united through the medium of a thin layer of cicatricial tissue and similarly in this suture line it is commonly believed that the shelving border and conjoined tendon will be firmly united by a narrow band of cicatricial tissue of greater width to be sure than seen after a primary union but still sufficiently narrow to resist the tendency to separate in the way Seelig described. The most important evidence regarding the value of this step in the operation is derived by direct observation both in cases of recurrence as well as in cases free from recurrence in which the patient's death has occurred from some intervening disease. Unfortunately as surgeons are not generally

allowed to operate on those recurrences for which they are held responsible, it is frequently difficult to be certain that any special recurrence is not the result of faulty technic in the primary operation. Some years ago I was told by a member of the staff of a hospital in this city to which a considerable number of patients with recurrence applied for relief that in a decided majority of these patients the primary operation had been done in the same hospital by internes without proper supervision. An error to which the inexperienced are exceedingly prone is to mistake the upper part of the cremaster for the conjoined tendon leading necessarily to an entire lack of a proper suture of that important structure. It is only when the technic of the primary operation has not been defective that observations regarding the relation between the conjoined tendon and shelving border can be of value and in such cases operated on primarily by both himself and colleagues, the writer has found, except at the point of recurrence, so close and firm a union of these structures that sharp dissection was necessary to identify and prepare them for resuture. In the discussion of Seelig's paper Dowd and Lyle reported cases in which the union of these structures was so firm that separation was impossible and Coley has reported similar cases in his review of Hernia in *Progressive Medicine* 1924.

While Seelig does not believe in the approximation of muscle to aponeurosis, he shares the general belief that the union of sutured aponeurotic or fascial planes is much more satisfactory. The overlapping of the upper and lower flaps of the external oblique aponeurosis as practised by the writer after a careful removal of all lining areolar tissue not only restores the normal dimensions of a dilated canal, but adds materially to its strength as well.

As an addendum or an alternative to the suture of the conjoined tendon to the shelving border, various observers have emphasized the value of the careful approximation of the transversalis fascia. This is desirable when the edges of the fascia can be identified which is not always an easy matter. This fascia, however, is closely united to the deep surface of the conjoined tendon and is necessarily approximated to the shelving border by the suture joining these two structures, leaving in the vent of union a more efficient fascial barrier than when the fascial edges are united alone as well as avoiding the danger of puncture of the external iliac vessels with the sheath of which vessels the transversalis fascia is continuous below.

Another measure evidently of great value, with which the writer has had no experience, is the use of detached long fascial strips in the suture of the deeper planes. This was originally practised by McArthur, of Chicago in the latter eighties when antiseptic surgery flourished and infection was common. McArthur tells me that he utilized threads from the aponeurosis of the external oblique, in place of the uncertain catgut to which the infection had been ascribed, and with excellent results. Gallie much more recently employs strips from the fascia lata and where close approximation is impossible with-

## REDUCIBLE OBLIQUE INGUINAL HERNIA

out tension, inserting them in much the same way as a stocking is darned. This method he especially advocates for large ventral herniæ and reports a considerable number of excellent results in cases considered inoperable by other surgeons. Whether such a "filligree" is more serviceable than the use of a detached flap is questionable. The writer has had excellent results in restoring abdominal defects due to extensive fascial sloughing, even when of very large size, by the transplantation of fascia lata flaps. Andrews, of Chicago, tells me that he has utilized similar flaps in the closure of large

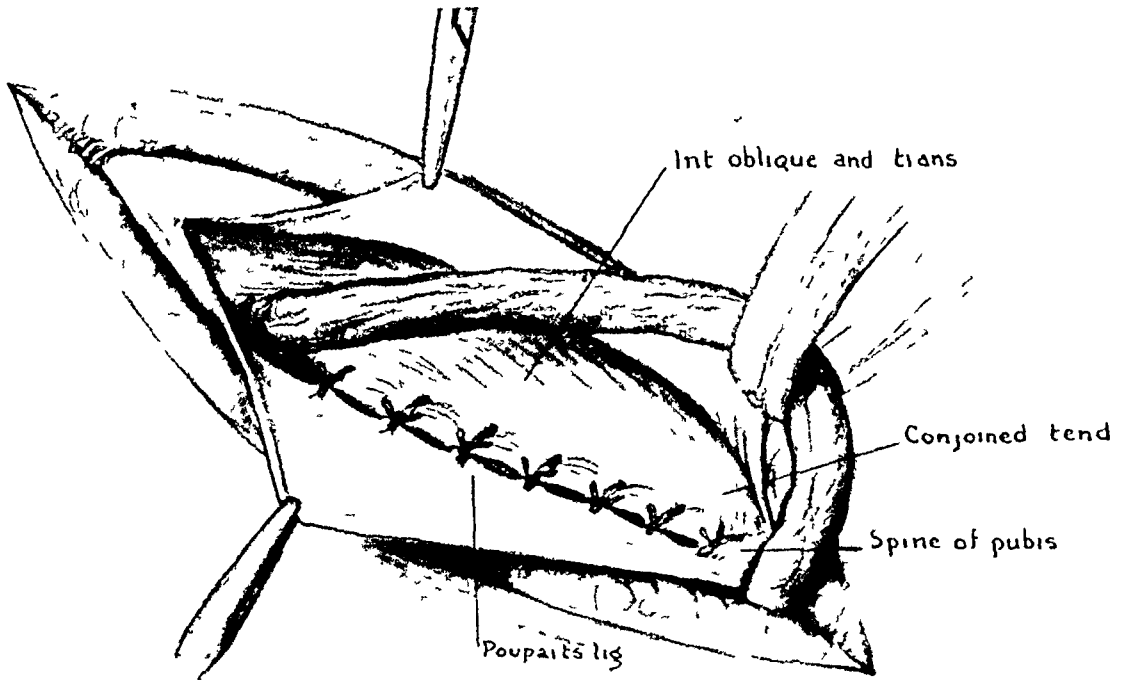


FIG. 3.—Stage III. Suture of conjoined tendon to pubic spine and shelving border.

inguinal herniæ with satisfactory results and the application of one or more such flaps would seem to the inexperienced more simple than the "darning" method advocated by Gallie. It is not probable however that any modification of the closure of the hernial orifice by some form of fascial suture or transplant will become a matter of routine except in those cases in which approximation of tendon or aponeurosis is either impossible or can be effected only under great tension. In cases of this character as well as where recurrence has followed a presumably satisfactory closure by the Bassini method, some such procedure is unquestionably indicated.

The present generation has witnessed almost a complete reversal in the question of the operative *versus* the non-operative treatment of inguinal hernia. Before antiseptic surgery strangulation in which taxis failed to relieve formed the sole indication. During the relatively short antiseptic era almost every operation was promptly followed even in the absence of infection by recurrence. Albert in Vienna correctly stated that most cases recurred within a year and that recurrence was certain although it might be delayed for a much longer period. At that time the application of a suitable

truss was usually preferred to operation. With the advent of aseptic surgery, and especially after the publication of the Bassini method, the popularity of operation rapidly increased, the larger number of cases being permanently cured or remaining free from recurrence for years. To be sure, after the wearing of a truss for a year or two, a hernia might occasionally disappear or at least give no indication of its presence. The writer recalls one instance of a good-sized reducible inguinal scrotal hernia in a strong young adult, in which a truss was worn for a year. It was then discontinued, and although thirty-five years have passed by, there has been no indication of a hernia at any time since the truss was discarded. A similar result was observed in a case of a femoral hernia in which after an interval of ten years, a hydrocele of the original hernial sac was excised at which time no communication whatever between the sac and the peritoneal cavity could be demonstrated. Cases of spontaneous cure are frequently observed in congenital herniæ of infants in which the usual pre-natal closure of the processus sacciformis does not take place until some time after birth. For this reason the writer believes that operation before the third or fourth year is justified only in those cases in which the hernia shows no decrease in size. Similarly in patients of advanced age operation is indicated only where a truss or some form of suspensory apparatus fails to keep the hernia under control. The writer recalls a voluminous reducible inguinal hernia in a male of seventy-eight which confined the patient to a recumbent position in bed or lounge. This was so unendurable in a patient otherwise still strong and active that the alternative of an operation was accepted, and although eighteen months afterward recurrence had taken place it was of small size and easily controlled by a truss. The possibility of a hernia increasing to such a size as to become finally uncontrollable, notwithstanding the wearing of a truss for many years, is, in the writer's opinion, sufficient justification for operation in every inguinal hernia in patients otherwise healthy in whom the reparative power is still unimpaired. The writer has repeatedly operated on patients who have unintentionally neglected to observe proper supervision in the application of a truss, in which, the hernia, as it increased in size, had slipped down behind the truss without the patient's knowledge. At best even a well-fitting truss is a nuisance and requires constant skilled supervision to maintain its effectiveness. As patients reach the fifth decade and inguinal regions, formerly flat, become convex from adipose accumulation, the difficulty of the accurate adaptation of a truss is correspondingly increased and frequently a source of much annoyance, especially in hot weather.

The question of the final result in the operative treatment of inguinal hernia is of the greatest interest. The writer presents no statistics. Especially in adults is it difficult to keep trustworthy records, for these patients frequently move and pass from observation. The writer has been accosted by former patients, on whom the operation was done in this city, on the streets of cities in the Middle West, and even as far away as London. It is pre-

cisely in this mobile element of the population that statistics would be of value, for it represents those who gain their livelihood by manual labor, while private patients, much more easily followed, usually have some sedentary occupation that is less likely to subject the abdominal scar to unusual strain. Not that vigorous exercise predisposes to recurrence. In fact, the reverse may be the case, which is well illustrated in a young, athletic male, in which a recurrence gradually disappeared when the patient began to row regularly in a crew. This was thirty years ago and the relief has been complete.

While statistics, based on the results of operative treatment in private

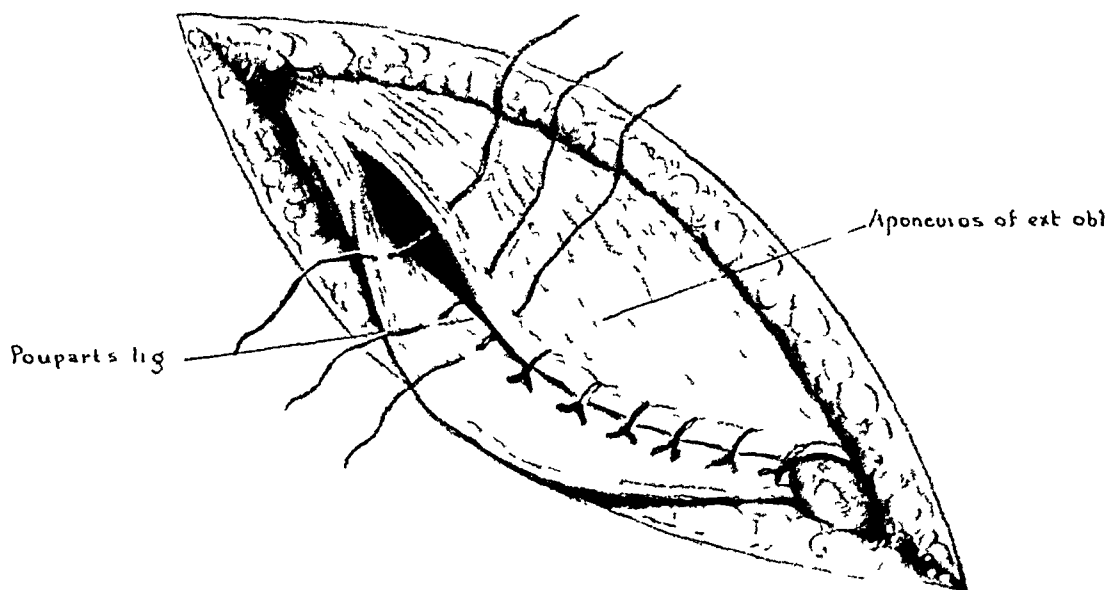


FIG. 4—Stage IV. Overlapping of external oblique aponeurosis, with formation of new external ring to outer side of pubic spine.

patients are more easily compiled, the fact that all error in such statistics is not excluded, is shown by the following incident. The writer was recently consulted by an adult of fifty in regard to a recurrence after an operation for inguinal hernia. A herniotomy had been done originally on both sides by a skilled surgeon. Both recurred, the recurrence being repaired by a different surgeon and now another recurrence had appeared. On inquiry as to whether the surgeon who had done the primary operation had spoken of any unusual anatomical weakness which might account for the unlucky recurrence, the patient stated that that surgeon had never been informed of the recurrence and to the best of his knowledge still regarded him as permanently cured.

On the other hand a surgeon may be unjustly blamed for an alleged recurrence. Thus several years ago the writer operated on a young married woman during the third month of her first pregnancy for an oblique inguinal hernia in which the sac was beginning to protrude through the external ring. About a year afterward a recurrence was said to have taken place although as the patient had moved to the western part of the State this could not be confirmed by a personal examination. The patient, however, placed herself again

in the writer's care and proved, on operation, to have a good-sized femoral hernia on the same side, while the original inguinal hernia showed no sign of recurrence. It is needless to emphasize in accuracies of statistics due to differences in the age of the patient, the duration and type of the hernia, variations in the muscular development of the abdominal wall and other factors which influence the strength of wound repair. Perhaps in syphilitics the success of a herniotomy is more satisfactorily tested than in healthy adults. In a case of this character nine years ago, the writer used a local anæsthetic in

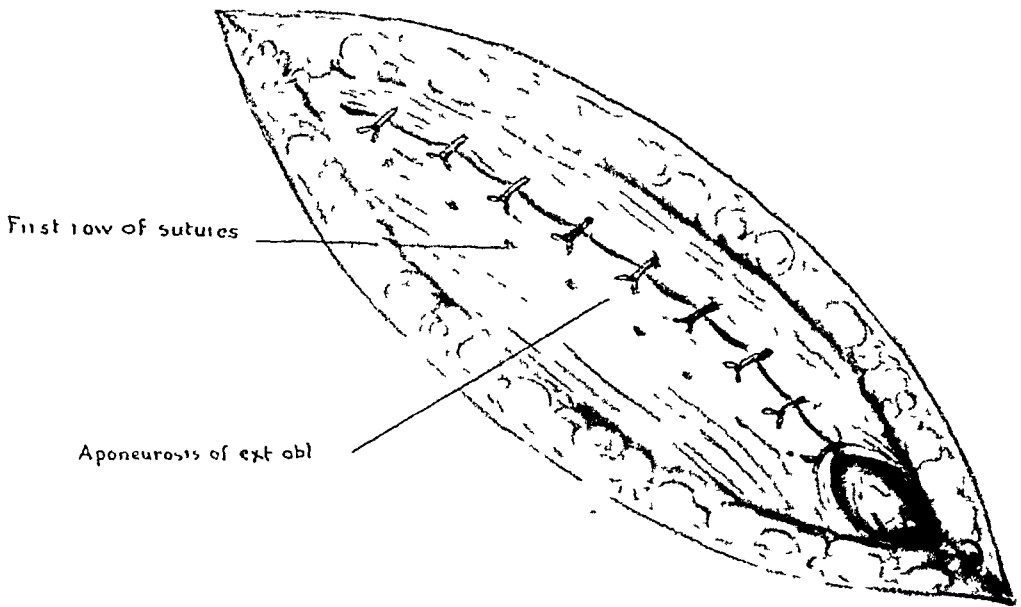


FIG 5 —Stage V Final row of sutures in the overlapping of the aponeurosis

an operation for a moderately sized reducible direct inguinal hernia extending into the scrotum, in which the wearing of a truss had become intolerable. While primary union was secured, the post-operative course was marked from the ninth to the fourteenth day by an irregularly high temperature accompanied by a sudden enlargement of the liver, which extended like a huge sponge, 4 inches below the costal margin and which, as the temperature subsided, as quickly returned to its previous size. I am told by the family physician that this patient still indulges in occasional alcoholic sprees and that each one is attended by a similar disturbance in the size of the liver and by an irregular temperature. Notwithstanding this habit, however, and the persistence of a markedly positive Wassermann, no recurrence of the hernia has taken place.

Perhaps the best criterion of the value of herniotomy is the verdict of the lay public. When patients, usually of the laboring class, voluntarily seek an operation which means confinement to bed for at least two weeks with a subsequent period of enforced idleness of equal length, it is indeed an indi-

## REDUCIBLE OBLIQUE INGUINAL HERNIA

cation that the permanent results are quite satisfactory. This has been for years and continues to be the case with herniotomy, and the popularity of the operation is such that even when patients are warned (and each patient should be warned) of the possibility of a recurrence, they are rarely deterred from seeking to obtain relief for a condition which, both while at work as well as at play, restrains their energy and range of activity. In the writer's experience recurrence, so far as he knows, is a rarity, especially so during the past twenty years during which time, as a routine measure in every operation, the writer has anchored the conjoined tendon to the pubic spine and has restored, by overlapping the divided aponeurosis, the normal dimensions of the inguinal canal.



# BROKEN-DOWN ABDOMINAL INCISIONS \*

A METHOD OF CLOSURE

By ARTHUR M. SHIPLEY, M.D.

OF BALTIMORE, MD

BROKEN-DOWN wounds have always been a very serious mishap in abdominal surgery. I have seen a considerable number of these accidents occur

in the various services of the University Hospital and in the majority of these patients, a fatal termination has been the result. Therefore, I have been particularly anxious to devise some method whereby the outcome might not be so disastrous. Somewhat different methods of abdominal closure are used by the different operators. I believe that tight tying of the sutures thereby producing a certain amount of necrosis, is a factor in a large number of these broken-down incisions. Most of these patients, however, have had some post-operative complication, either pneumonia, some disturbance in the kidney function or a persistent cough. The wounds, of course, are less apt to do well in patients who are emaciated or whose resistance before operation has been lowered from any cause. In my own experience, there is hardly anything more disturbing than to be called to see a patient with a broken-down abdominal incision with protrusion of coils of the intestines in the dressings.



FIG. 1

usually necrotic the different layers of the wound are more or less sealed

\* Read before the American Surgical Association, May 4, 1925

## BROKEN-DOWN ABDOMINAL INCISIONS

together and the exposed intestine dull in color and often covered by exudate. The patient usually has symptoms of intestinal obstruction, as some portion of the intestine is pinched between the edges of the wound. An anæsthetic given to such a patient is always hazardous because in the act of going to sleep, other coils of intestine are apt to be protruded and the peritoneal cavity become still further contaminated. If one attempts an ordinary closure of such a wound the necrotic edges interfere with union and a few days after the second closure the wound is apt to break down again. In order to obviate this difficulty the following procedure has been used.

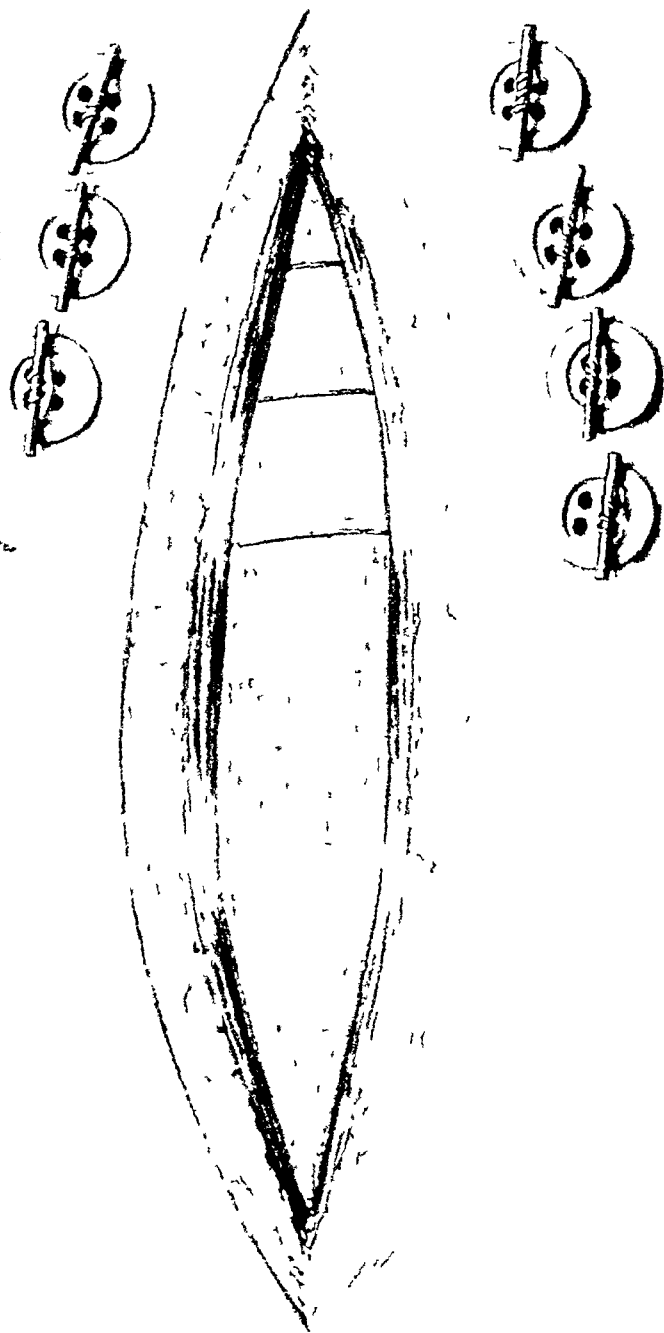


FIG. 2

The patient is carried to the operating room, the dressings carefully removed, and the patient cautioned to keep as quiet as possible. He is urged not to cough, and if coughing is necessary not to do so without warning. The abdomen around the edges of the wound is shaved and cleansed with alcohol, ether and iodine. The coils of intestine are not handled at this time (Fig. 1). The wound is then draped and the abdominal wall infiltrated with novocaine for a distance of about three inches around the wound. The intestines are then gently pushed back within the peritoneal cavity and a quadrilateral piece of gauze containing about eight layers, a little larger than the opening in the peritoneum is then placed on top of the coils of intestine just below the level of the peritoneum (Fig. 2). This prevents further protrusion of the intestines and also acts as a drain. Interrupted sutures of No. 22 silver wire are then introduced through the entire thickness of the abdominal wall starting about an inch to an inch and a half from the skin edge and coming out through the peritoneum just lateral to the wound.

margin (Fig 2) The wire is then introduced through the entire thickness of the abdominal wall on the opposite side in the reverse manner, using a large curved needle These sutures are placed at about one-half inch intervals and an ordinary bone button is threaded over each end of the wire and the

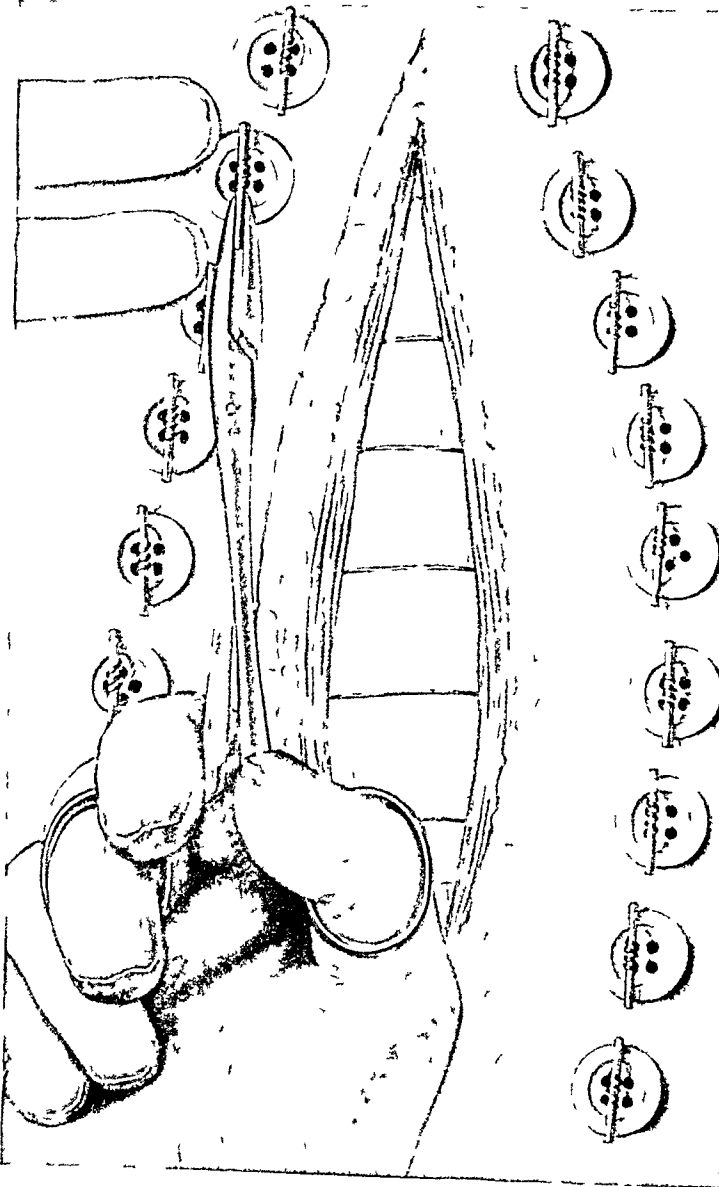


FIG 3

wire is drawn moderately tight by twisting a matchstick down on the button (Fig 3) These interrupted wire sutures lie outside of the layer of gauze which thereby protects the underlying intestine from erosion by the wire, and prevents coils of intestine from protruding between the wire sutures Another longitudinal piece of gauze is placed down in the wound external to the wire This strip is narrow and is put in for drainage as it is not hoped to get primary union because of the necrotic edges (Fig 4) The edges of the wound are then approximated by tightening the wire After a few days when the wound edges are healthy and red and granulations

present, the gauze under the wire becomes loose and can be easily removed The wires are then further tightened in order to closely approximate the posterior or peritoneal layer of the wound (Fig 5) A small pack of gauze is left for a few days longer external to the wire for drainage By the end of ten days all gauze can be removed and the wound edges closely approximated, after which union takes place by granulation rather promptly Five patients have been treated successfully in the Surgical Clinic of the University Hospital, Baltimore, Md, by the above method

## BROKEN-DOWN ABDOMINAL INCISIONS

CASE I—This man was a young negro who had been shot through the abdomen about an hour before admission. He was operated on by the Resident. He was partially drunk and took a bad anæsthetic. An upper right rectus incision was made because the wound of entrance was in the upper abdomen. A number of perforations of the small intestine were found and closed. In closing the incision, continuous plain catgut was used for the peritoneum and interrupted chromic gut for the rectus sheath. This suture line was safeguarded by interrupted silkworm gut sutures through the skin, subcutaneous tissues and anterior sheath of the rectus muscle. The skin was closed with silk. This is the usual closure in the Surgical Clinic of the University Hospital. The patient developed pneumonia following operation and was quite ill. He coughed a great deal and on the tenth day after operation complained of pain following a coughing spell. When the wound was examined it had broken down throughout its length, and a number of coils of small intestine were found in the dressings. I was called to see him. The edges of the wound were necrotic and covered by exudate. The intestines were fairly clean. The peritoneum was somewhat dull and glazed.

Under local anesthesia the wound was closed by the method described above. Patient made a good recovery and left the hospital at the end of four weeks with a solid abdominal wall.

CASE II—This patient was a colored man between the ages of fifty and sixty. He had had a very large irreducible scrotal hernia for years. He came in with his hernia strangulated and was operated on by the Resident. The hernia was a very large one and in addition to being strangulated was adherent. There were a number of coils of small intestine which were strangulated and there was a sliding hernia of the cecum as well. Considerable difficulty was encountered in freeing the cecum and the tissues were much handled. A long incision was necessary. After the intestines were reduced the hernia was closed with chromic gut and the skin with silk.

This patient developed almost complete suppression of urine following the operation. This persisted for a number of days. There was some œdema of the extremities and considerable moisture in the lungs. Following this he began to improve but developed a cold and cough. On the eighth day after operation he complained of pain in the wound and was dressed. The wound was found completely broken down and several

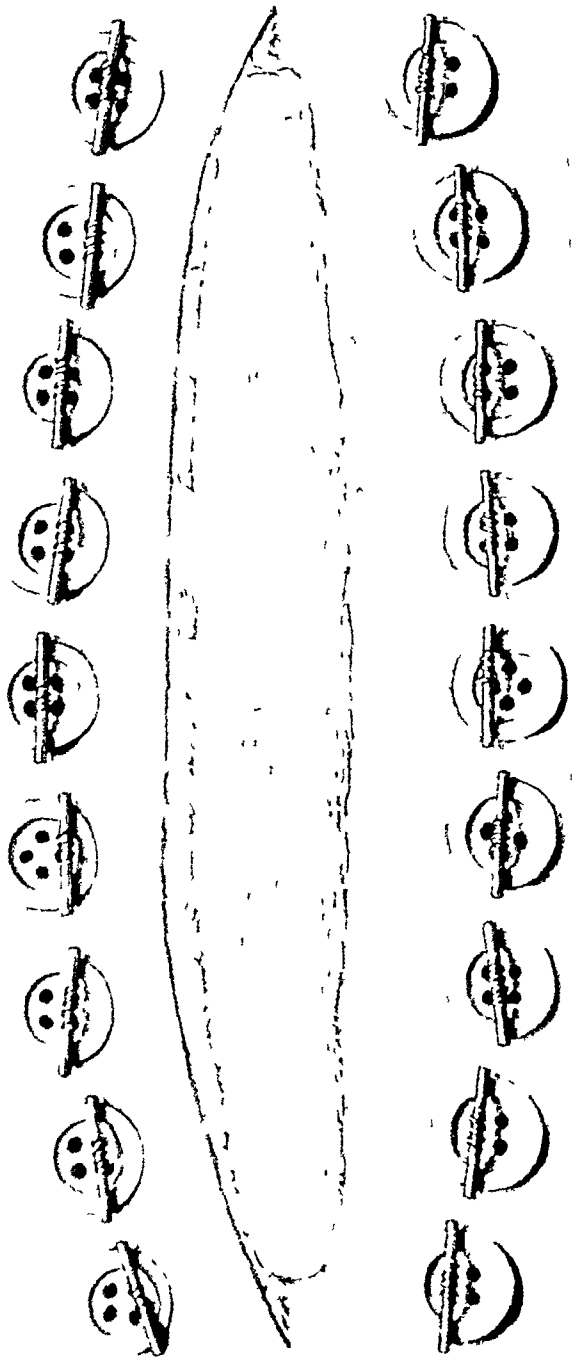


FIG. 4

coils of small intestine were found in the dressings. I was called to see him and found the edges of the wound heavily infected and covered by exudate. The coils of the intestines were also covered by exudate and there was considerable discharge. The wound was closed by the method described above and this patient also made an uneventful recovery.

**CASE III**—This patient was a negro, male, who had been shot in the abdomen about an hour before admission. His wound of entrance was in the upper abdomen and a right rectus incision was made. There was a perforating wound of the stomach and considerable hemorrhage from a wound in the mesentery. The perforations were sutured and the abdomen closed without drainage. This patient also developed pneumonia with a great deal of cough. On the twelfth day following the operation, his wound broke down with protrusion of a number of coils of small intestine. The same operative procedure was performed under local anesthesia and he also made a good recovery.

**CASE IV**—This patient was operated on by Dr. C. A. Reifschneider for acute cholecystitis. The gall-bladder was distended and acutely inflamed and the head of the pancreas was enlarged and indurated. Cholecystostomy was done. The abdominal incision was closed around the drains. Plain catgut was used in the peritoneum, chromic gut in the fascia and silkworm gut through the skin. Subcutaneous tissue and fascia. The skin was sutured with interrupted silk. He was having a good convalescence, the drains were all out and the abdomen was soft until the fourth day after operation when he developed some cough which became progressively worse. On the seventh day after operation he suffered severe pain in his incision. The nurse noticed some blood in the dressings and when they were examined there was protrusion of the intestines in the incision. Doctor Reifschneider saw the patient immediately and there was rather more than the usual exudate because the wound was a drained one. The intestines, however, were clean and glistening. A secondary closure was done after the manner described above. Gauze was removed on the twelfth day. One silver wire was removed twenty-six days after the operation and the remaining ones removed one

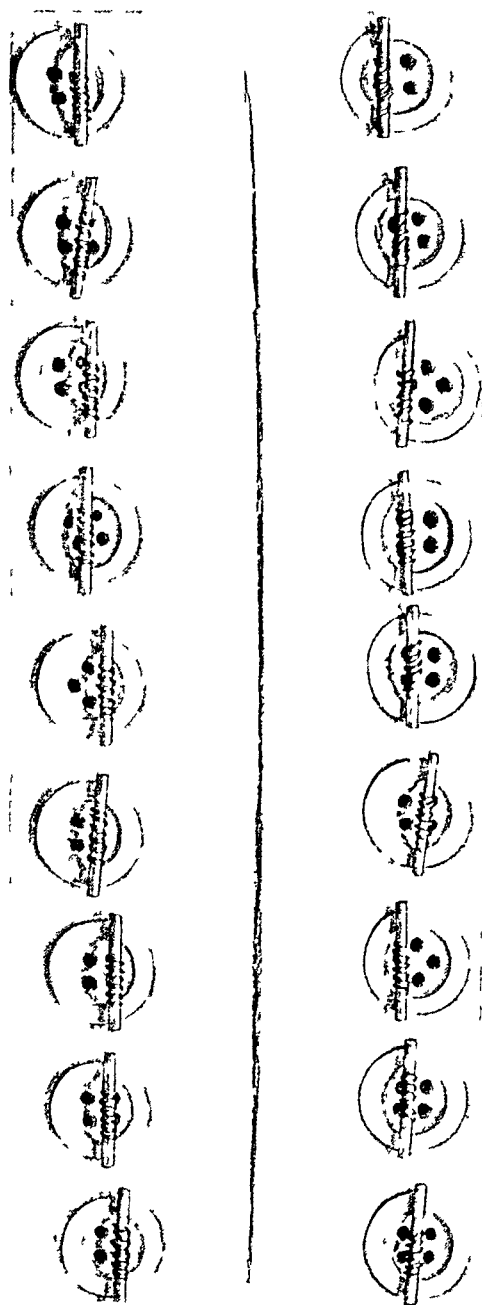


FIG 5

month after operation. He has been seen from time to time since the operation and has had no further trouble from the incision.

**CASE V**—This patient was operated on by me. He was a white man sixty-two years of age, who came in with a diagnosis of pyloric obstruction. He had lost a great deal of weight from starvation at the time of admission, and at operation an extensive carcinoma of the pylorus was found which caused almost complete obstruction.

## BROKEN-DOWN ABDOMINAL INCISIONS

The carcinoma had extended along the posterior wall to such an extent that posterior gastro-enterostomy could not be done. An anterior gastro-enterostomy was done, as the anterior wall except at the pylorus was free from cancer. After operation, the patient developed an obscure chest complication with cough and fever and considerable expectoration. No definite pneumonia could be made out, but he was quite ill for a number of days. His abdomen continued soft and he had no pain in the abdomen and no vomiting. The eleventh day after operation his abdominal wound broke down throughout its length and a number of coils of small intestine protruded through the incision. There was very little infection. The edges of the wound, however, were necrotic and covered with grayish exudate.

Under local anæsthesia, the described procedure was done. He made a good recovery and left the hospital four weeks later with his incision healed. This happened only a few months ago, and he is still living.

## PARTIAL RESECTION OF THE KIDNEY\*

BY EDWARD STARR JUDD, M D

OF ROCHESTER MINN

RESECTION of the kidney has been only rarely performed in recent years. During the period of evolution of renal surgery, partial resection was not infrequently advised and carried out. Czerny performed the first partial resection for a tumor of the lower pole of the kidney in 1887. Later Kummell resected the lower pole of a kidney for echinococcus disease. Kuster reviewed thirty cases in which a partial resection was performed, four for tuberculosis, two for stone, three for hydronephrosis, and five for tumors. Eighteen of the patients improved, seven did not improve, and five died. Apparently the results following partial resection did not find favor with the surgeons of that day as very little further is to be found in the literature concerning the subject. The mortality in this type of case (16 per cent) was comparatively low in the early period of renal surgery, nephrectomy was then being performed with a mortality of from 25 to 35 per cent.

We know now that in the presence of a tuberculous process or a neoplasm, nephrectomy should be performed whenever possible. Under ordinary circumstances, if the opposite kidney is functioning normally, resection of the diseased area with an attempt to preserve a small, possibly infected fragment of a kidney, is not entirely satisfactory. Such an operation entails considerable risk and not infrequently a secondary emergency operation. On the other hand, there are certain cases of localized infection, formation of stone, and limited hydronephrosis which would readily lend themselves to a partial resection of the affected kidney.

Young recently reported a case in which he had resected the upper third of the right kidney for localized pyonephrosis and stone. The kidney had been operated on previously and there were extensive adhesions. A slight depression in the body of the kidney suggested duplication, but the pelvis was single. The patient was cystoscoped some time later, the remnant of the kidney was functioning, although apparently reduced. Young also cites a case reported by König in 1919, in which resection and suture of the atrophic upper pole were performed and a stone removed.

A few years ago, Hinman made a most important contribution to the experimental studies of compensatory hypertrophy, these have since been partially confirmed experimentally, and our clinical evidence supports his contention. His experiments show that renal reserve and compensatory hypertrophy effect a counter-balance following unilateral nephrectomy, and also that in unilateral diseases without nephrectomy, an additional factor which he calls renal competition is active in the final readjustment. He believes that the

---

\* Read before the American Surgical Association, May 5, 1925

## PARTIAL RESECTION OF THE KIDNEY

unilateral lesion creates an unequal ability to work, one side being healthy and active, and the other diseased and less active, and that such activity is essential to renal growth. The gradually increasing demands on the kidney for work stimulates the tissue to greater activity and results in renal hypertrophy. Hinman also believes that inactivity is just as significant of renal atrophy and that a diseased renal mass in competition with a hypertrophic mate gets less and less stimulation as the other side becomes more efficient, and so progressive inactivity leads to a disease atrophy. It is evident, then, that the existence of this renal reserve power and compensatory hypertrophy on one side and what he calls renal competition and disease atrophy on the other, is a most important consideration in any surgical disease of the kidney. He cited his experiments to show that many of the failures from plastic operations for unilateral hydronephrosis were due to the fact that the diseased kidney had been badly injured and the opposite kidney had

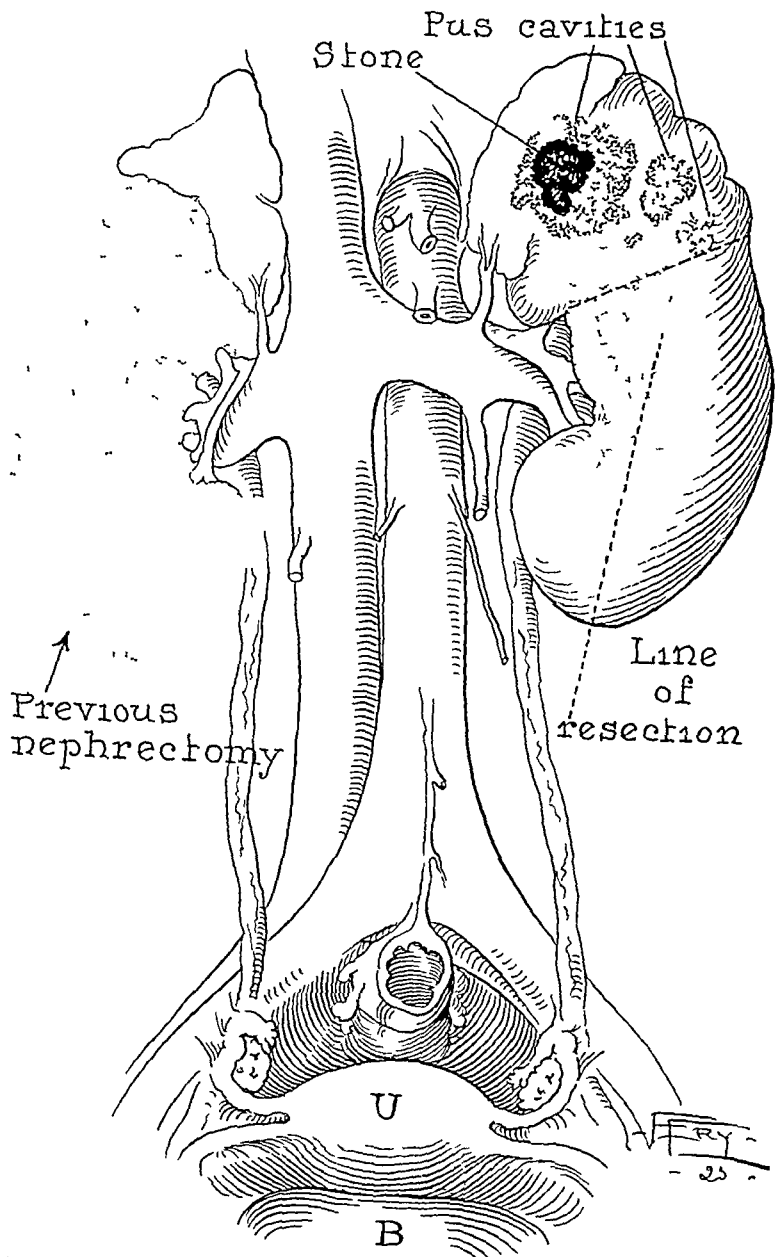


FIG 1—Right kidney removed, pyonephrosis of the upper third of the left kidney

been called on to increase its activity. Regardless of the fact that the diseased kidney could be so changed as to overcome any mechanical difficulties, it was often impossible for it to resume its work because of lack of stimulation, all of the work being done by its hypertrophic mate. Hinman believes that the initial response on the repaired side is toward repair, but it is too feeble to compete with the hypertrophic side, and that the final atrophy is not a progressive toxic degeneration as much as it is a disuse atrophy.

The foregoing conception of hypertrophy and atrophy of the kidney must



have a very important bearing in operating in cases of bilateral renal lithiasis and hydronephrosis, and especially in performing resections. It is obvious that to resect a kidney when it is known that the opposite kidney is doing practically all of the work will not be advisable. The only thing to be gained by saving a piece of renal tissue in any case in which the opposite kidney is uninjured would be the slight protection which it would offer in case of

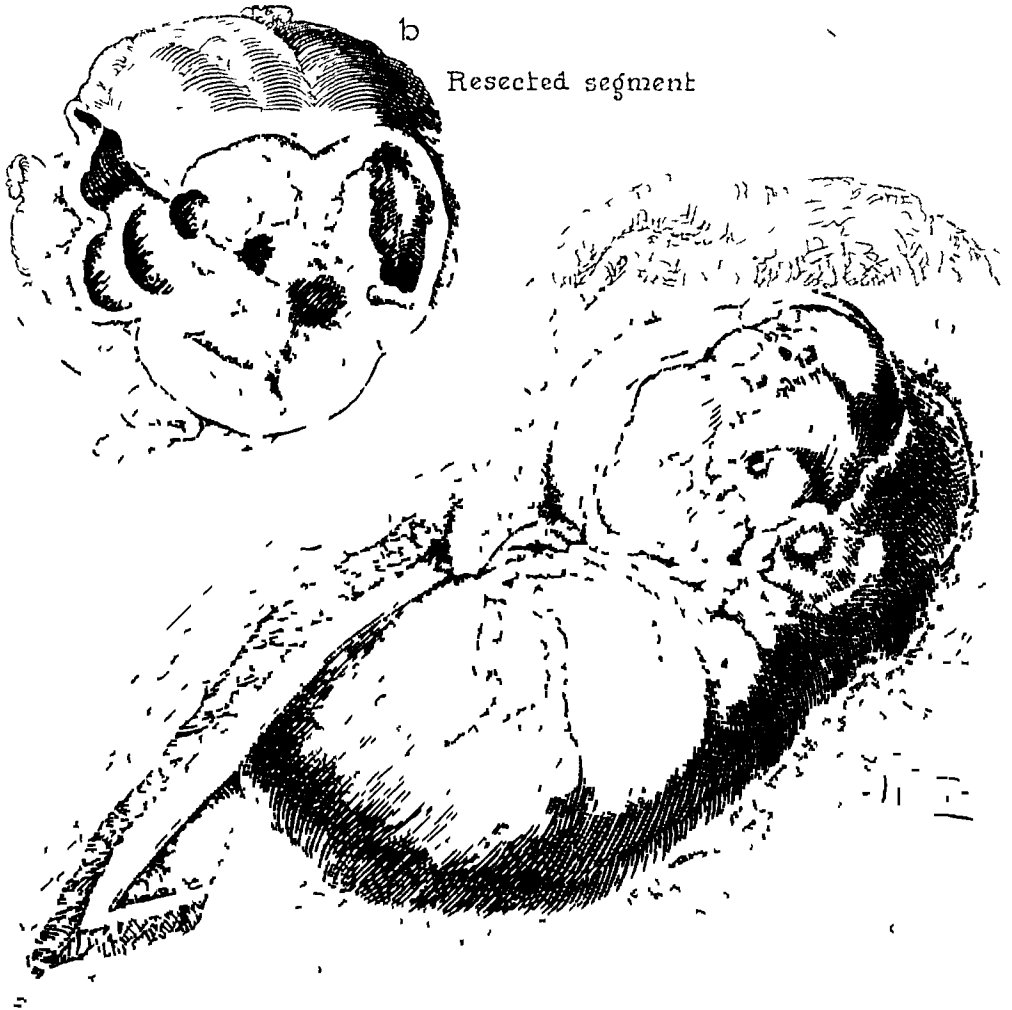


FIG. 2 —a Left kidney with diseased upper segment, b segment resected

trauma to the good kidney. Undoubtedly in some of the cases in which a resection was performed, there was immediate atrophy of the renal tissue saved, because the opposite kidney was enlarged and perfectly capable of carrying on all of the work.

In an occasional case, partial resection may be the only operation permissible, the diseased portion may be associated with, or be part of, the only remaining functioning segment of renal tissue, making it essential to conserve as much of the kidney as possible. This was true in one case in which the right kidney had been removed and the left contained a localized pyonephrosis and stone. The work of Tuffier, thirty-five years ago, justifies such an opera-

## PARTIAL RESECTION OF THE KIDNEY

tion Tuffier demonstrated that there is a definite regeneration of tissue in the remaining renal segment if the portion allowed to remain is sound. Kummell excised a portion of a kidney in two cases for stone and abscess formation. He cites Tuffier's work in which it was estimated that a man could live with from 80 to 100 gm. of sound renal tissue.

**CASE I—Partial Resection of a Single Kidney**—A woman, aged thirty-two, had had attacks of fever, chills, and pyuria for seven years, and recently a dull aching pain in the right side associated with frequency of urination and nausea. The right kidney was enlarged and the urine contained pus. The X-ray revealed several shadows in the region of the right kidney, and a single large shadow in the region of the left. Cystoscopic examination disclosed a functionless right pyonephrosis and infection and stone in the left kidney, which, however, was functioning normally.

A right nephrectomy was performed and the patient recovered readily from the operation. Three months later the left kidney was operated on. In the upper pole was a large abscess which contained one large and several small stones. The lower pole was in fair condition. The adrenal was adherent to the abscess area, it was dissected free and pushed back. The abscess area containing the stones was then resected. Tissue to the amount of about two-thirds of a normal kidney remained after the resection. The edges of this portion were approximated with a continuous running suture. Several large stay sutures of catgut were also inserted. A moderate amount of urine drained through the incision for a number of days, but

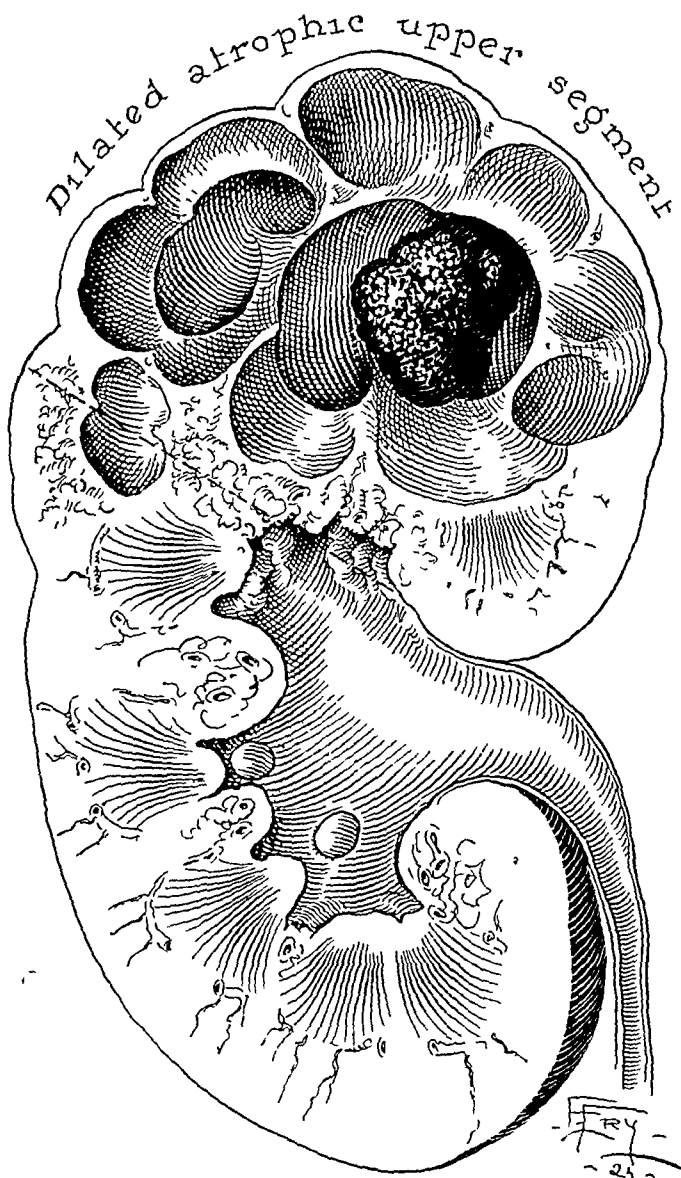


FIG. 3.—Line of resection of diseased single kidney.

on the fourteenth day the wound was clean and solid. The patient had no further trouble. Five months after operation she became pregnant, and seven months later gave birth to a child that lived fourteen days. One year later her blood urea content was normal and she was in good condition. (Figs. 1, 2, 3 and 4.)

The blood urea in this case had been normal before operation and during convalescence accurate records were kept. On the second post-operative day the blood urea was 72 mg. for each 100 c.c., on the fourth day 92 mg., on the ninth day 56 mg., and on the thirteenth day 44 mg., which would seem to indicate that the renal function was probably very definitely interfered with at the time of the resection. After the patient returned home her local physician kept the record. In about two months' time the urea

content was normal and remained normal thereafter. The only other sign of renal disturbance at any time, in spite of the intervening protracted labor, was a trace of albumin. This case seems to demonstrate definitely that a part of one kidney is sufficient



FIG. 4 —Closure of line of resection of kidney in two layers

for normal renal function, even if there is an added hazard, such as may accompany pregnancy

Resection is often indicated in cases of double kidney. The position of the double kidney does not differ from that of the normal kidney, and its relation to normal surrounding structures is similar. The double kidney, however, is

## PARTIAL RESECTION OF THE KIDNEY

usually abnormally elongated. It varies in size, depending on the degree of union of the two segments and the extent of the interrenal area. Externally there may be no evidence of duplication, although in most cases the division of the two segments is indicated by a depression varying from a small notch to a broad deep groove.

The capsule may dip into the renal mass completely separating the two segments. It is necessary, surgically, to know the extent of the separation and the integrity of each segment in order to make any conservative or partial resection, and it is necessary to remove all of the diseased segment and leave a normal functioning unit. In cases of extensive infection of one segment the adjacent intervening tissue is generally affected. The infection may not have extended to the other segment sufficiently to involve the pelvis, but on resection it may be spread by surgical manipulation and rapidly invade the apparently normal tissue. If there is tuberculosis, resection should rarely be considered. Tubercles and giant cells were found

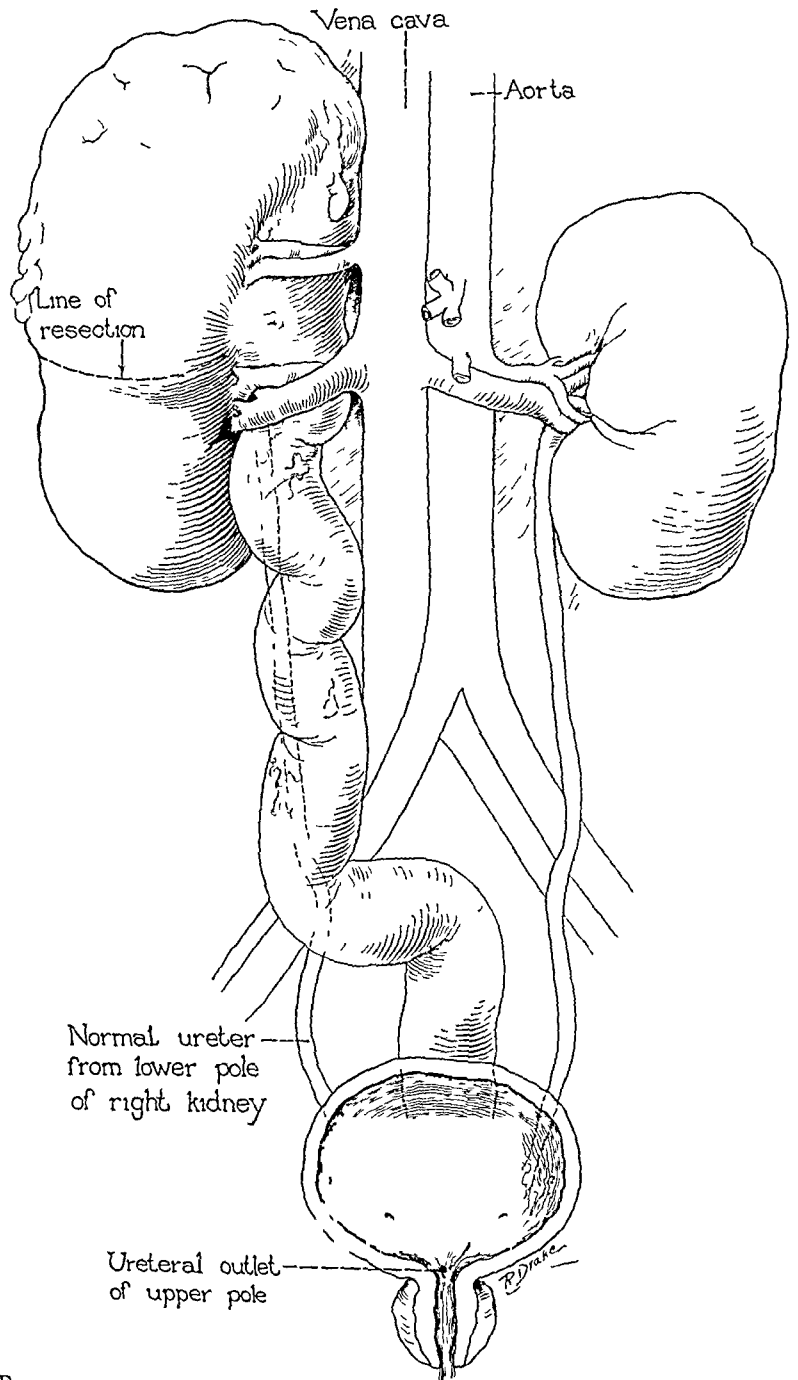


FIG 5 —Large dilated upper segment of the kidney with a tremendous ureter opening into the posterior urethra

in the interrenal tissues in six cases in which nephrectomy was performed for tuberculosis in double kidney, in two of these the process was limited grossly to one segment. A tuberculous stricture at the point of juncture of the two ureters may cause disease in both portions of the kidney, one segment being tuberculous and the other hydronephrotic from ureteral obstruction. In several cases I have resected tuberculous kidneys, sending to the laboratory pieces of

tissue excised from the segment which I proposed to save, only to find that the tissue contained tubercles. Sometimes a cicatricial band separates the two segments, grossly walling off the infected area and apparently offering an ideal condition for operation. Resection in the presence of any extensive

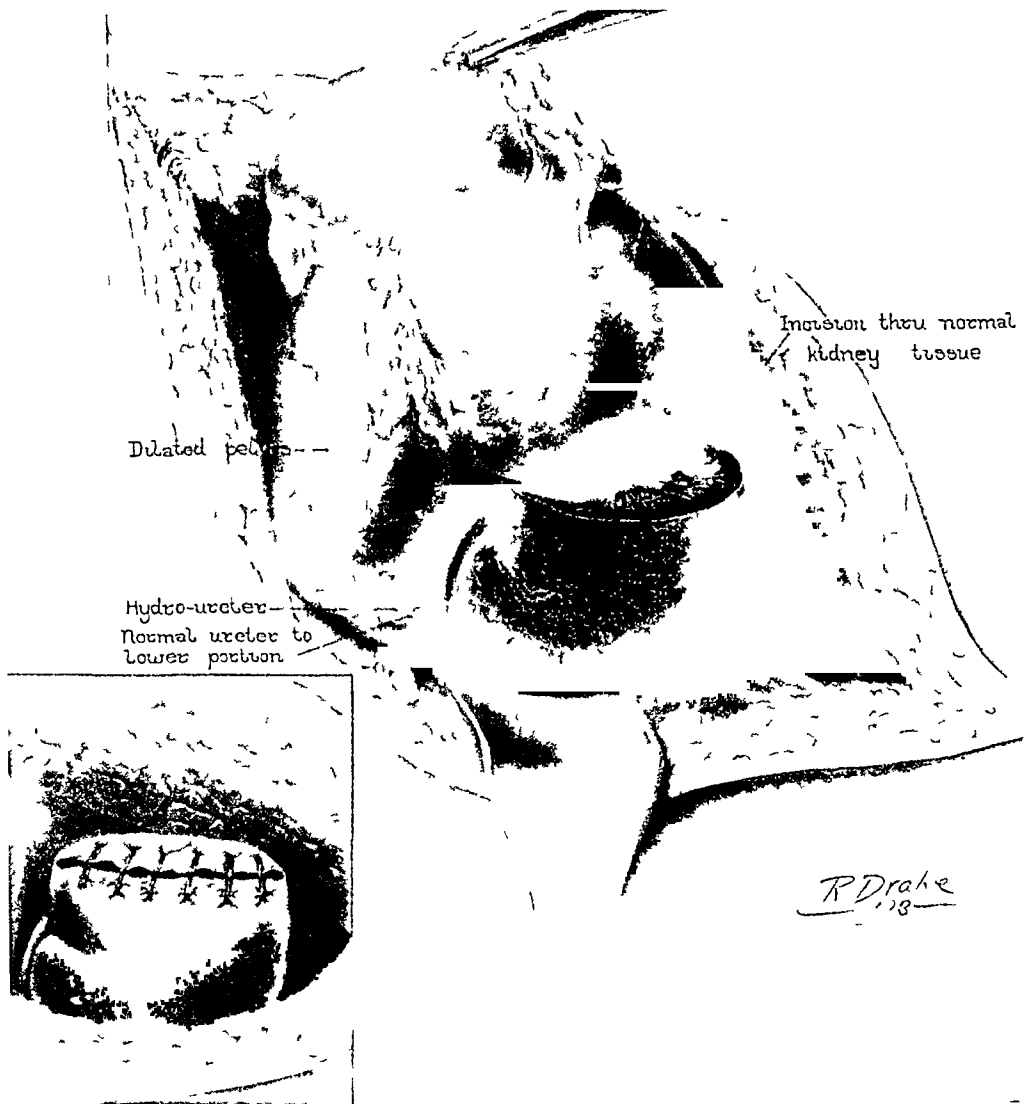


FIG 6 —Resection of the upper dilated segment of a double kidney with a partial ureterectomy

infection is likely to result in a stormy post-operative course, and complete nephrectomy may be necessary later.

Opening into one of the calices or the pelvis may cause a urinary sinus. This often occurs in cases in which a resection is done, but the sinuses heal promptly and it is likely that as the technical steps in the operative procedures are developed, this difficulty will be eliminated.

The segment which remains must have a sufficient blood supply. In most cases in which the pelvis is completely divided, the parts have a separate blood supply. The arteries arise from the aorta and the veins extend to

the vena cava. The diseased segment, generally the upper, may be smaller than the remaining portion and may receive only a small branch from the aorta or from the main renal artery, the main branch of which enters the larger segment and furnishes sufficient blood to permit resection. Eisendrath studied the blood supply in thirty-five cases of double kidney, in fifteen cases one artery supplied both segments, in fifteen there was an artery for each segment, and in five, three arteries supplied both segments.

In operating, the kidney is approached through a posterolateral incision, its mobility will depend on the vascular pedicle, the extent of the lesion, and amount of perinephritic adhesion. The vascular connections to the normal segment are first examined to make sure that they are adequate. The pedicle to the remaining segment is then clamped, cut, and ligated. Anomalous vessels are not uncommon and must be looked for. The kidney should be resected through normal tissue, and a portion of this tissue left attached to the segment to be removed in order to avoid possible error and infection. Sometimes the diseased segment may be composed merely of a fibrous hydronephrotic sac containing little or no functioning renal tissue, and the dilated sac may be peeled from the remaining kidney as though it were a simple cyst. The renal stump is closed with a double interrupted or mattress suture which dips deeply into the renal tissue. Any bleeding, or any area not well approximated, may be controlled with a running stitch. The area of resection is then covered by a portion of the fatty capsule stitched loosely over the line of suture. The area of resection may drain for several days, and a drainage tube is used.

If the bifurcation is high, the ureter may be removed just a little above the juncture of the normal ureter. Care must be taken not to injure the common ureter or the one draining the adjoining segment. If there is ureteral obstruction in cases of complete duplication, it is generally at the ureterovesical juncture. The ureter is dilated and not infrequently infected, it should be removed completely.

There were six cases in the present series in which a double kidney was resected. Four of these cases were reported in an earlier paper by Braasch and Scholl. Reports of two follow.

*CASE II—Ureter from One Segment of the Double Kidney, Opening Extravesically*—A man, aged forty-nine, had had intermittent pain in the right loin for twenty-six years. The urine contained much pus. X-ray examination of the kidneys, ureters and bladder was negative. Cystoscopic examination revealed two normally placed ureteral orifices in the bladder and a third in the posterior urethra. A pyelogram of the right kidney from which the urine was normal, and also an injection into the ureter opening into the urethra, disclosed a double kidney on the right side. The lower segment was apparently normal in size and function. The upper segment was markedly dilated, and the ureter from it was from 3 to 5 cm in diameter. The upper segment was not functioning.

On exploration through a posterolateral incision, the right kidney was found to be twice normal size with a double blood supply, two pelves, and two ureters. The lower segment was normal in size and consistency, as was the condition of the pelvis and ureter. The upper segment was hydronephrotic and the ureter was tremendously dilated. The

vascular pedicle to the upper segment was clamped, ligated, and cut. The upper half of the kidney was removed, the line of incision passing through normal renal tissue. The slight bleeding which occurred when the kidney was divided was controlled by continuous and interrupted sutures. The wound was dry at the completion of the operation.

The segment remaining was equivalent to about two-thirds of a normal kidney. The wound was closed with two soft drains, these were removed on the eighth day. The patient had an uneventful convalescence. One year later, he reported that he had had no further urinary trouble (Figs 5 and 6).

**CASE III—Pyuria with Occasional Attacks of Chills and Fever Since Childhood**—A girl, aged eighteen, had had frequency for four years, and at one time difficulty in voiding. During the last year she had aches and pains in the left lumbar area and upper abdomen. On examination the right kidney was palpable. The urine contained a moderate amount of pus but renal functional tests were normal. Rontgenograms of the kidneys, ureters, and bladder were negative.

Cystoscopic and pyelographic examinations revealed complete duplication of the left pelvis and ureter. The lower pelvis was slightly dilated and infected, and the ureter from this segment entered the bladder laterally and above the orifice from the upper segment. There was practically no function in the lower segment. The urine was normal from the upper segment which was functioning well. The right kidney was normal.

The left kidney was exposed through a posterolateral incision. The kidney delivered well into the wound and was found to be duplicated with a definite line of demarcation between the two segments. The upper segment felt normal. It was of good size and had a complete blood supply. The ureter was not dilated and was not adherent to the ureter of the lower segment. The lower segment was sac-like. When

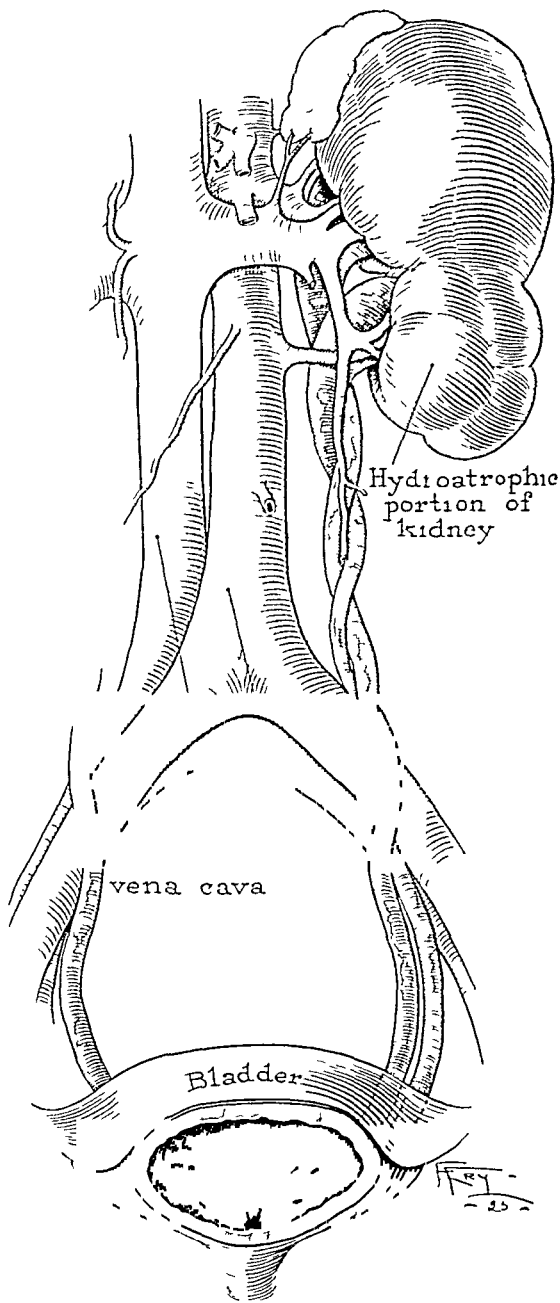


FIG 7—Atrophic lower segment of double kidney with complete duplication of the ureters. The ureters make two complete spirals, one around the other.

filled with fluid during the cystoscopic examination, it was of fair size, but at operation was found to be atrophic and contracted. It received an artery from the aorta. The renal vein from this segment connected with that from the upper segment. The two segments were separated by making an incision at the sulcus. The vascular pedicle to the lower segment was clamped and cut, and the ureter was cut and ligated about 12 cm below

## PARTIAL RESECTION OF THE KIDNEY

the kidney The incision was drained but healed promptly After operation the patient's father, who was a physician, stated that this was the first time since childhood that her urine had not contained pus (Figs 7 and 8)

It was my intention to discuss here only resection of the kidney in cases

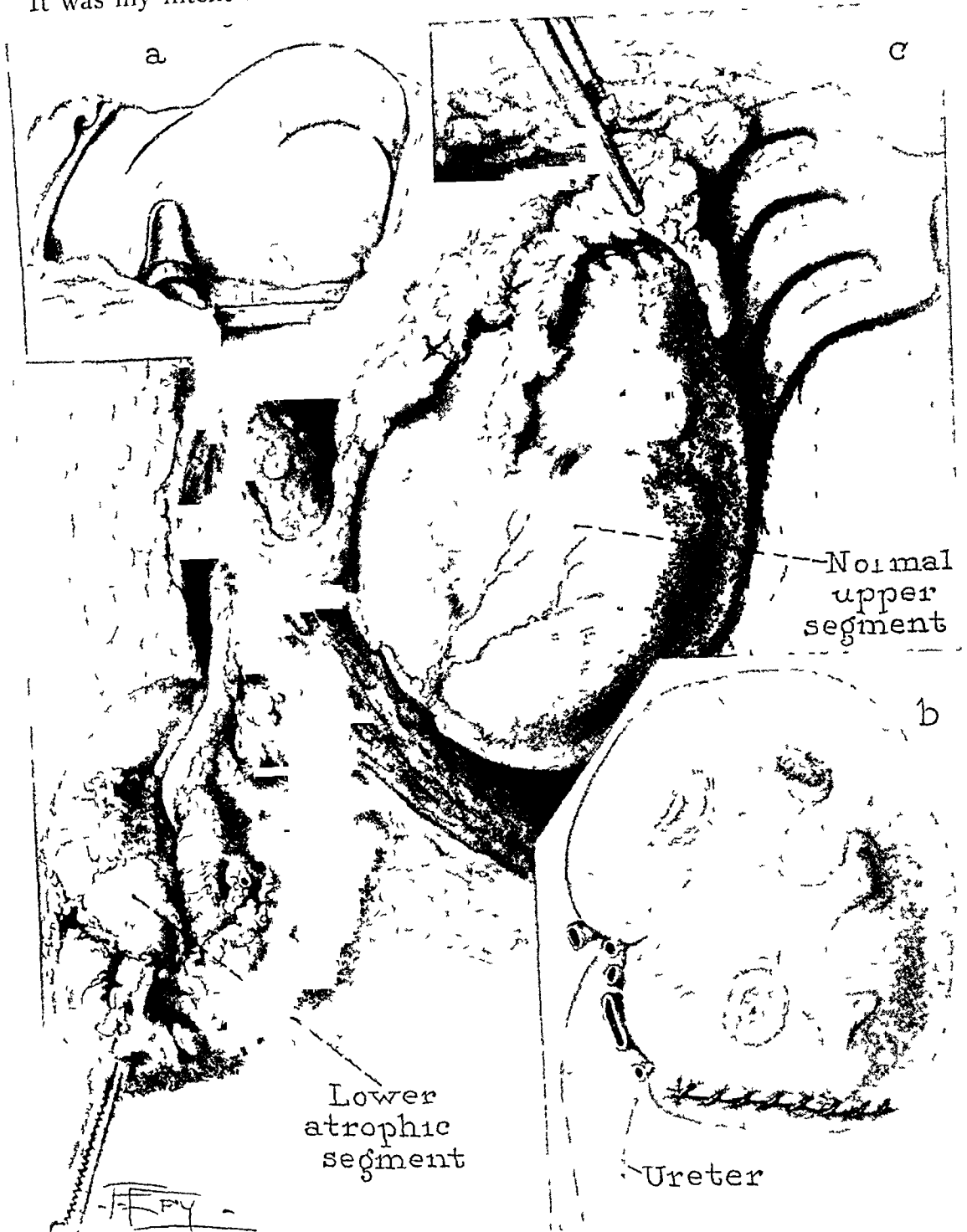


FIG 8—*a* Line of incision, *b* Resection of lower atrophic segment of a double kidney The line of suture is covered with fat and the normal segment so placed in incision as to permit the ureter to be straight *c* Line of closure of resected area of kidney

of solitary or double kidney, but I wish also to relate my experience in resecting horseshoe kidneys The problems encountered in making a diagnosis in such cases and the plan of operative procedure are quite different



from that in the ordinary cases of renal disease. The numerous and anomalous vessels, and the fixation and location of the renal mass make an anatomic recognition of horseshoe kidney necessary in order to carry out successfully any surgical procedure. The blood-vessels and the pelves in horseshoe kidneys lie anteriorly. In some cases there may be a single artery from the aorta which divides and supplies both renal masses. Accessibility for surgical intervention in a horseshoe kidney varies inversely with the degree of fusion. In most cases these kidneys occupy a position median and caudal to normal kidneys. The more complete the fusion, the lower the position. Often it is best to approach the horseshoe kidney through an anterior incision.

I have performed resection in nine cases of horseshoe kidney. The immediate risk of the procedure, if the infection is rather extensive, is fairly high. In one case tuberculosis was present, but it seemed to be confined to one segment only. In this case, the wound drained freely for several months and then healed permanently. The last report gave no evidence of a recurrence of the tuberculosis.

**CASE IV—Horseshoe Kidney**—A man aged thirty-five had had a traumatic rupture of the right kidney repaired in December 1916. Since then he had had repeated attacks of pain in the right lumbar region and sometimes severe colic. He weighed 146 pounds. The systolic blood-pressure was 90 and the diastolic 65. The specific gravity of the urine was 1.020, there was acid reaction, albumin 2 pus 4 and 1 erythrocyte. Hemoglobin was 55 per cent, and the leucocytes numbered 6200. The Wassermann reaction was negative, the phenolsulphonephthalein return was 50 per cent in two hours. Rontgenograms of the kidneys, ureters and bladder disclosed a large stone in the right kidney. A diagnosis of right calcareous pyonephrosis was made. May 28, 1919, the wound was opened and white mucus discharged.

A right subscapular nephrectomy was performed June 6, 1919. A posterolateral incision was made. Right pyonephrosis was found with chronic nephritis. The kidney removed, was small and atrophied, weighing 68 gm. There was considerable scar tissue about it and it contained a pyonephrotic sac 3 cm. in diameter. The kidney was stripped out from its capsule. No stones could be felt in the pelvis of the kidney or in the ureter, and there was too much infection to warrant exploring the peritoneum at this time.

The patient returned April 7, 1921, because during the last year he had had several attacks of pain in the left renal area with fever. He weighed 153 pounds. The systolic blood-pressure was 108, and the diastolic 68. Urinalysis revealed a specific gravity of 1.016, acidity, albumin 3, pus 4 and 1 erythrocyte. Hemoglobin was 80 per cent, and the leucocytes numbered 7800. The phenolsulphonephthalein return was 45 per cent in two hours. Rontgenograms of the kidneys, ureters and bladder showed a large shadow over the right renal area. A cystogram revealed pus 4 on the right side. A lead catheter was passed up to a stone, 4 by 4 cm., at the ureteropelvic juncture. The ureter was dilated 4, and acting as a diverticulum. The patient was advised to have a right ureterectomy.

April 13, 1921, a right rectus incision was made, and a partial nephrectomy and ureterectomy performed. An iodoform gauze pack and two drainage tubes were inserted. The lower end of the right ureter was exposed and divided, and ligated with chromic catgut. Dissection was carried up to a pocket, apparently a horseshoe kidney, containing a stone. The right part had been removed previously. The stone was apparently in the pelvis of the kidney. A piece of renal tissue about 5 by 3.75 cm., was removed from the lower pole of the right kidney which extended across to the spine. The patient

## PARTIAL RESECTION OF THE KIDNEY

returned July 19, 1922, because of a right lumbar sinus which drained purulent material but no urine. The phenolsulphonephthalein return was 45 per cent in two hours. The specific gravity of the urine was 1.018, there was acid reaction, albumin 1, and pus 1. July 24, the sinus was explored, curetted, and packed with gauze. In January, 1924, it was reported that the lumbar sinus was still draining.

*CASE V—Double Meatus, Ureter and Pelvis on Right Side, with Stricture of Inner Ureter Above Bladder and Dilatation Above Stricture*—A woman, aged thirty-two, came to the clinic August 14, 1911. For six or seven years she had had pain and soreness through the right side of the abdomen. Four years before, she had had an attack of severe pain in the right flank, which radiated anteriorly to the bladder, lasted about two hours, and was associated with a constant desire to urinate. No blood or stone was passed. Four weeks before coming to the clinic there had been a similar attack. Several physicians had diagnosed the symptoms as gall-stones.

At examination the patient weighed 125 pounds, urinalysis revealed a specific gravity of 1.017, an acid reaction, albumin 1, but no pus. Rontgenograms of the kidneys, ureters and bladder were negative. A cystogram and pyelogram revealed duplication of the meatus on the right side, about 1.25 cm. from the other, also a duplication of the ureter and pelvis on the right side, and a stricture of the inner ureter just above the bladder with marked dilatation of the ureter above the stricture. Clear urine was coming from each meatus. The left kidney was normal. An exploratory operation, performed August 28, disclosed the double ureter on the right side, stricture of the inner ureter at the bladder wall, and dilatation above, the size of the small intestine. The ureters ran separately to a point about 15 cm. from the bladder where they approximated and ran in the same sheath for a distance of several centimetres, separating again above, and entering the separate pelves very close to one another, the diseased ureter entering behind and the sound one in front. Each half of the kidney had its own blood-vessels. The diseased ureter was the upper one, the upper artery and vein were tied. On sectioning the kidney in the central point of the apparent separation, there was no bleeding. The upper ureter was injected with methyl blue. When cut across, the side injected was not opened, the section being made about the middle of the kidney. A long anterior oblique incision was made and the upper and lower muscle split. The lower part of the ureter was tied and turned in like an appendix, about 3.13 cm. from the bladder, at a point where the sound ureter which lay a little below to the outer side was so closely adherent as to make it dangerous to separate it. The sound ureter went into the lower pole on the anterior side, and the unsound ureter posterior to the upper half. The patient made an uneventful recovery and left the hospital on the twelfth day after operation. One year later she reported that she was perfectly well.

*CASE VI—Double Ureter and Pelvis of Both Kidneys with Stones*—A man, aged forty-five, came to the clinic October 9, 1911. Seven years before, he had had hæmaturia and passed a large stone, and since then there had been pus in the urine. Two years later he had had severe chills at intervals of several months, followed by high fever, from 104° to 105°. During the last three years there had been intermittent pain in the left upper abdomen and around the left lumbar region, with tenderness over the left kidney. The knee-jerks disappeared. Urinalysis revealed a specific gravity of 1.013, an acid reaction, a faint trace of albumin, an occasional red blood cell, and pus. Rontgenograms showed a shadow in the area of the left kidney. A cystogram revealed duplication of the ureter and pelvis of the left kidney, and a stone in the lower pelvis. The urine from this pelvis was cloudy, indicating considerable destruction of the lower half of the kidney. The urine from the upper pelvis was clear. A pyelogram disclosed a stone in the lower pelvis, which was moderately enlarged. Apparently there was a fairly distinct division between the two halves of the kidney.

October 19, half of the left kidney and half of the two ureters and two pelves were resected through a post-oblique incision. The pelvis in the lower half was dilated, infected and contained a stone and about an ounce of infected material. The lower

half of the kidney was soft and about half the size of the upper. The ureter was large and inside the pelvis it contained a papilloma. The sound ureter ran posterior to the diseased one, and entered the bladder below. The sound ureter passed behind and to the outside of the diseased one at the brim of the pelvis. The blood-vessels of the lower half were distinct from those of the upper. The line of demarcation between the diseased and sound ureters was well outlined. Catgut was used to tie the ureter and to suture the kidney. One cigarette drain was inserted.

The patient was examined again April 2, 1912, when he complained of severe pain over the left kidney. A cystogram revealed a double ureter and pelvis on the right side. Function was good on the right side, but only fair on the left. The remainder of the left kidney was removed April 4. It contained a chronic infarct and was hydro-nephrotic. The patient was seen several times afterward, and the urine always contained pus. He died January 31, 1924, from renal insufficiency.

CASE VII—*Bilateral Duplication of Ureters and Pelves*—A woman, aged forty-one, came to the clinic May 30, 1918. Her appendix and right ovary had been removed fifteen years before. Two and one-half years before, she had had acute nephritis and bloody urine for eight weeks. During the last year she had had several attacks of fever, pain in the left renal area, and much pus in the urine. One month before, there had been a severe attack of pain radiating to the bladder.

The patient weighed 146 pounds. The systolic blood-pressure was 160, and the diastolic 100. Urinalysis revealed a specific gravity of 1.012, an acid reaction, albumin 2, pus 2, and red blood cell 1. Hæmoglobin was 69 per cent, and the leucocytes numbered 5000. The phenolsulphonephthalein return was 60 per cent in two hours. The Wassermann reaction was negative. Röntgenograms of the kidneys, ureters, and bladder showed multiple shadows in the left renal area. A cystogram and pyelogram disclosed bilateral duplication of the ureters and pelves, multiple stones in the lower pelvis of the left kidney. The differential phenolsulphonephthalein return was 10 per cent from the left upper pelvis, and only a trace from the lower. The return from the bladder was 35 per cent.

A partial left nephrectomy was performed through a posterolateral incision July 9, 1918. Four rubber tissue drains were inserted. The left kidney contained two pelves, the lower half consisted of a hydronephrotic sac, about 12 cm in diameter, with stones. It would, however, seem that the hydronephrosis was caused by a kinking blood-vessel rather than by a stone. The large sac containing stones was dissected out and the lower portion of the kidney, all of which was diseased, was amputated, the upper two-fifths with small pelvis and ureter being preserved. The cut surface was closed with catgut. The patient continued to have fever and local infection. A cystogram, taken August 3, showed that the remaining portion of the kidney, possibly equal to one-third of a normal kidney, was still functioning. August 15, the remainder of the left kidney was removed by a subcapsular nephrectomy. July 11, 1923, word was received that the patient was perfectly well.

CASE VIII—*Double Kidney with Branched Stone in the Lower Pelvis*—A man, aged twenty-seven, came to the clinic March 10, 1920. Appendectomy had been performed the year before. At the age of twelve the patient had begun to have attacks of pain in the right side and back about twice a week, but never severe enough for a hypodermic. For the last three years there had been almost constant soreness on the right side with repeated attacks of acute pain. During the last year a hot water bag had been applied every night for relief. The appendectomy did not afford relief. There were no urinary symptoms.

The patient weighed 111 pounds. The systolic blood-pressure was 120, and the diastolic 66. Urinalysis revealed a specific gravity of 1.023, an acid reaction, albumin 0, pus 1, and red blood cells 2. Hæmoglobin was 70 per cent, and the leucocytes numbered 10,600. The phenolsulphonephthalein return was 65 per cent in two hours. Röntgenograms of the kidneys, ureters, and bladder showed a shadow over the right renal area.

## PARTIAL RESECTION OF THE KIDNEY

A cystogram revealed turbid urine from the right meatus. A differential functional test proved that the renal function was normal on both sides. The first pyelogram showed a small highly situated pelvis suggestive of duplication. The X-ray shadow was below the pelvis. The second pyelogram showed complete duplication of the pelvis with the shadow obscured by the lower pelvis which was otherwise normal. The diagnosis was branched stone in the lower pelvis of a double kidney.

Right heminephrectomy was performed March 23. Exploration revealed two pelves and two ureters, the ureters joined about 1.88 cm below the two pelves. The lower third of the kidney contained a branched stone and a number of small stones, also small separated cortical abscesses containing stones. The lower ureter had been closed by a stricture at the juncture of the two ureters. It was ligated close to the juncture of the upper ureter. The lower third of the kidney was dissected out completely and removed in the groove which formed a distinct division between the upper two-thirds and the lower third. The remainder of the kidney was stitched over and covered by a fatty fascial flap. The patient made an uneventful recovery except for a persisting sinus which discharged serous material. A cystogram April 15 revealed clear spurts of urine coming from the right meatus. A report October 11, 1923, stated that the patient was perfectly well. The sinus remained open for one and one-half years, and then closed permanently.

### CONCLUSIONS

- 1 It is entirely feasible to perform resection even in cases of solitary kidney, and it should be done whenever a more complete removal of the infection can be accomplished.

- 2 Resection of double kidney is practical, provided the disease is definitely confined to one segment. Just as in cases of solitary kidney the resection can undoubtedly be made whether the kidney is double or single.

- 3 For the present, one should be contented with nephrectomy in most cases of tuberculosis. Even in what appears to be very early cases, the infection usually involves more of the renal tissue than can be demonstrated except by microscopic examination.

- 4 Before resecting renal tissue, we must take into consideration the amount of renal hypertrophy and atrophy, so that we may save a segment of the kidney that will be of some service to the patient.

# METHODS OF URETERAL REPAIR AND TRANSPLANTATION

By CHARLES H. MAYO, M.D.

OF ROCHESTER, MINN.

EXSTROPHY of the bladder is a serious, uncomfortable and dangerous affection. It is as well most disagreeable for those who are necessarily associated with the sufferer. The mortality from such anomalies has been stated to be 50 per cent within the first ten years of life, only one of seventy patients reaches the age of seventy. Many have associated defects which add to the seriousness of the condition.

The Röntgen-ray indicates that in most of these cases of exstrophy spina bifida occulta co-exists, it may, in fact, be responsible for the exstrophy. In females the uterus is quite often bifid, or even completely double with a double vagina. Pregnancy and normal childbirth have been rarely reported in such conditions. One patient with a bifid uterus operated on at the clinic twelve years ago by the method described, married three years ago and gave birth to twins during the last year.

Transplantation of the ureters has been performed in sixty of ninety-four cases of exstrophy. In one case a dead kidney on one side, from total obstruction of the ureter, made but one ureteral transplant possible into the recto-sigmoid. This patient, operated on seven years ago, has continued in good health.

The constant rubbing of the exposed mucous membrane of the bladder against clothing and absorbent dressings may incite it to malignant change. I have seen four cases of carcinoma of this area, three of the patients are now dead.

With experience in several methods of operation for the relief of these distressing conditions, I am opposed to any method of developing a new bladder sac by using the mucous membrane, skin flaps, or skin grafting. No nervous or automatic control of the outlet can be established, and the more completely the bladder is developed the more dangerous is the condition of the patient. Neither do I recommend any form of closed intestinal pouch as an artificial bladder, since it is as susceptible to sepsis, has no automatic control, and hence leads as surely to chronic pyelonephritis. The Coffey technic is better than that described by the Russian and Polish surgeons who surround the ureter with the whole thickness of the bowel and thus prevent the valve action secured by the Coffey procedure.

A few changes in the technic have been developed which relieve some of the possible temporary complications of the operation. The operations I have performed have been intraperitoneal. Judd has performed the operation extraperitoneally by exposing and dividing the ureter extraperitoneally, open-

---

\* Read before the American Surgical Association, May 6, 1925.

## URETERAL REPAIR AND TRANSPLANTATION

ing the peritoneum, drawing out a loop of sigmoid for the anastomosis, after which it is replaced and fixed within the peritoneum, the ureter remaining behind the peritoneum until it pierces the wall of the bowel.

The intraperitoneal operation should be performed on the right ureter first, as the sigmoid is more difficult to handle on the right side after being fixed by an anastomosis on the left side. The incisions are oblique abdominal. The ureter can be seen attached to the back wall of the pelvic peritoneum. Its situation can be determined by the wave of peristalsis in it when the point of a forceps is drawn across its covering layer of peritoneum. The peritoneum is opened and the ureter separated down to a point from 2.5 to 4 cm above the bladder. The ureter is divided and held in forceps and the lower end ligated. The peritoneum is then closed by suture, just leaving the ureter loose as it passes through the opening in it. A needle with No. 2 chromic catgut is now passed 0.6 cm up the lumen of the obliquely cut end of the ureter, out through its wall, and then passed in again 0.3 cm further on. It is then carried down the lumen of the ureter again and out at the open end. Two knots are tied and the short end of catgut 6.25 cm long, is not cut but is passed into the lumen upwards its full length. This is a most important recent development in technic. The long end is left hanging for future use. The bowel is now cut longitudinally, in line with, or down, the centre of a longitudinal muscle band 3.75 cm long. This cut does not open the mucous membrane. The sharp edge of the knife is pushed against each side of the cut muscle and peritoneum, separating the cut edges 0.90 cm. With a sharp small pointed knife a puncture of the same size as the ureter is made in the mucous membrane at the lower end of the incision in the bowel. The outer flap of the incised bowel is trimmed at the upper end to just the depth of its dissection in order to make room for the ureter to lie in the trough against the mucous membrane without being pinched at this point. The ureter is stripped and loosened for 6.25 cm. It may become kinked and fail to deliver urine for two or three days through a half paralyzed lower end of ureter. The curved needle with the thread of chromic gut that was left hanging from the lumen of the ureter is now passed into the lumen of bowel by way of the puncture described and out through the bowel wall 1.5 cm below the opening, the thread drawn tight draws the ureter into the bowel.

A needle bite is now taken in the wall of the bowel and the thread tied to fix the end of ureter within the bowel at this point. In suturing the dissected flaps, every other stitch catches the outer tissue of the ureter to fix it. The peritoneum is now closed over the ureter by interrupted sutures. A running suture is employed to cover these sutures as well as the fixing suture which holds the end of the ureter in place.

With slight modifications this is the Coffey plan of anastomosis. It permits of free compression of the ureter by pressure of contents of the bowel against the mucous membrane, closing the ureter without interfering with the ureteral peristalsis. This method, I believe, is better than folding the whole thickness of the bowel around the ureter, because the stiff tube prevents the

pressure of the solid or fluid contents of the bowel from acting as a valve to allow egress of urine without entry of bowel contents into the ureter. In nearly all cases urine is absorbed by the bowel for a few days, as it is like a Murphy drip of salt water. There is almost no absorption from the second ureteral transplant after the ten or twelve days necessary to establish the first tolerance. With only half the urine in the bowel at first, there is less trouble than if both ureters are transplanted the same day. The urine, by following the short end of thread lying in the ureter, can always leak into the bowel regardless of slight kinks in the ureter which might otherwise be obstructive. Nearly all cases show some evidence of pyelitis, which soon disappears. Children under four should not be operated on as they must be old enough to attend to their own clothing and toilet. Within a short period, the urine should be retained during the day from two to four hours, during the night it is usually retained for eight hours.

The mucosa of the bladder with ureteral stumps is removed about one or two weeks after the second ureter is transplanted.

The mortality is very low for the apparent seriousness of the operative procedure, being but 13.33 per cent. in the sixty patients operated on. Operation is justified by the relief which follows it. The condition is rare, occurring in only one in 50,000 births, but in spite of its rarity, the rate indicates that a number are born every year who will require relief.

# IMPLANTATION OF AN OVARY\*

BY WILLIAM L. ESTES, M.D.  
OF BETHLEHEM, PA.

PHYSIOLOGISTS and clinicians are able now to differentiate two qualities in ovarian function, namely, (a) the genetic and (b) the purely hormone quality. The Graffian follicles found especially in the superficial or cortical areas of the ovary carry the genetic functions, and the interstitial cells in the stroma of the mid-gland region possess the hormone qualities.

Menstruation and many of the physiologic phenomena of ovulation will continue if a part of an ovary be preserved in its proper position, or if only a part of an ovary can be saved and it be implanted or transplanted within the blood and lymph circuit of the abdominal cavity. This is well known and well established. It is not yet fully determined that all the hormone functions will be preserved if the implanted ovarian fragment be a mere slice of the superficial part of one ovary.

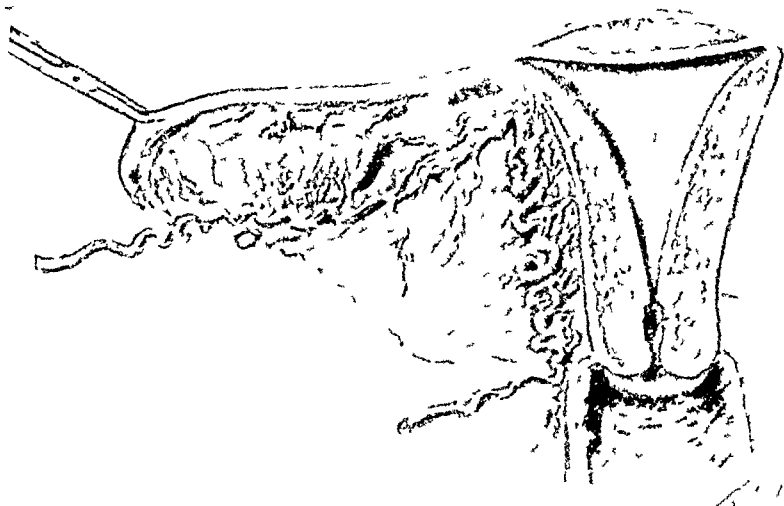


FIG. 1.—This is to show the blood supply of the ovary. The small vessel which runs along within the folds of the ovarian ligament is indicated. This should be preserved.

It is very sure that when the oviducts are entirely lost or firmly closed that sterility will result even if ovulation and menstruation should continue.

Also many and various nervous phenomena are apt to develop in sterile women whose Fallopian tubes are permanently closed and there is no possible way for the ova to reach the inside of the uterus.

In short, the conditions for the normal functioning of the generative organs and ovulating cycle with all the physiologic phenomena this implies, require more than Graffian follicles, their maturation, rupture and the resulting corpora lutea. For full and complete function, the interstitial cells of the ovary must also be preserved so that they may function, and as was said the ova should have a discharge avenue into the uterus and there exercise their usual stimulus for involution, etc.

There remains still the question whether the most disagreeable nervous phenomena, and the sometimes tremendous psychic storms which follow the complete removal of all of both ovaries in young women are due to the loss

---

\* Read before the American Surgical Association, May 6, 1925



of the genetic functions, the loss of the hormone function, or to the loss of both of these functions of the ovary. As the thyroid and ovarian physiologic interrelationship is so close, one might easily reason that the loss of the ovarian hormone might have a very far-reaching effect. The psychic effect of the complete and irretrievable loss of the generative functions is always bad. The preservation of as much as possible of ovarian stroma is, therefore, the



FIG 2—This shows the manner in which the tube should be excised. The artist has not represented the technic quite right. The incision for the excision of the tube from the uterine horn should go much deeper, that is to say to the mucous lining of the uterus. This produces somewhat of a crater-like depression into which the ovary should be fitted.

duty of every surgeon who must operate on the internal generative apparatus of a young woman.

Furthermore cases in which the oviducts are completely and hopelessly destroyed should, when it is possible, have some avenue made or the ovary be so placed, that ripe ova may find an entrance into the uterine cavity.

Conditions possible for fertilization and pregnancy may be brought about, if functioning ovarian stroma be implanted upon the mucous lining of the uterus directly over the inner opening of one or both Fallopian tubes in the horns of the uterus.

This is what is accomplished by the method of implanting ovaries, I wish again to describe and to recommend after twenty years of experience in the use of the method.

In regard to pregnancies I make no extravagant assertion or claim. Pregnancy may and has occurred after the operation but in the majority of the cases it has not occurred. If, however, it should in forty-six cases occur five times, the method being unobjectionable as compared with other operations for retaining a part of the ovary, it is certainly worth continued use in the conditions for which such conservative attempts are indicated.

*Conditions for Which the Operation is Adapted*—In women between fifteen and forty years of age, who for any reason have had complete irremediable stenosis or destruction of the Fallopian tubes, the operation is indicated. This is not meant for cases where there is simple constriction at one place from twisting, flexions or adhesions. These may be remedied without removal of the tubes. The operation is indicated and may be employed in cases where most of the tube is stenosed and so diseased it would not be safe to retain it, that is to say, in all sorts of obliterative salpingitis. It is recommended in cases of gonorrhœal or tuberculous salpingitis, when the tubes are hopelessly diseased, but the ovaries are not wholly affected, in the

## IMPLANTATION OF AN OVARY

various inflammatory conditions, except streptococcus hæmolyticus, which may invade the pelves of women, and by continuity or contiguity destroy the tubes

The necessity in these implantations is, that the whole of both ovaries shall not be diseased and that the uterus shall be in such condition it may be left in place. It is desirable and best to retain as much of the ovarian stroma as the disease and condition make possible. Even a small portion of the ovary saved will serve for the continuation of menstruation, however. I have implanted an ovary in the stump left after a subtotal hysterectomy with perfect success, and though of course menstruation did not recur, the phenomena of ovulation did go on regularly.

*Technic of the Operation*—In cases in which the necessary slight manipulations are not apt to prove dangerous on account of a possible rupture of an abscess into the peritoneal cavity, after carefully bathing and disinfecting the

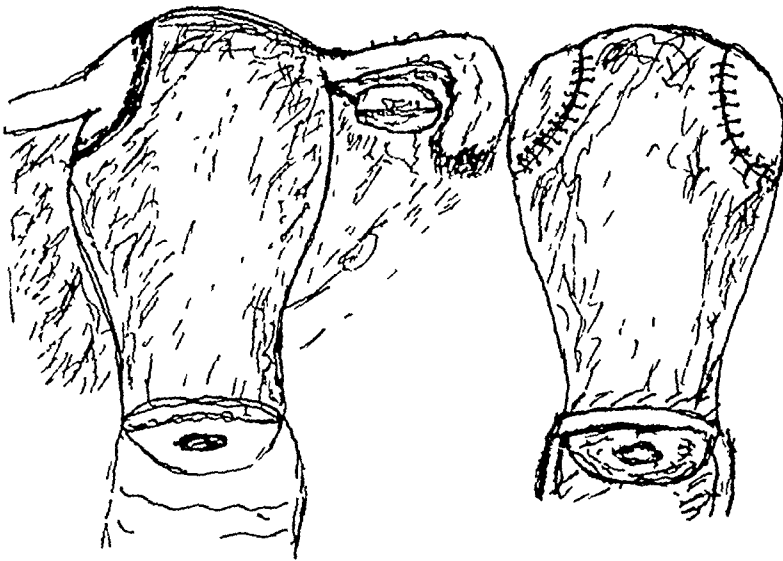


FIG 3b—These two rough schematic figures give a better idea of the excision of a tube and the fitted-in implants of the ovary

vulva and vagina, the uterus is cuetted, swabbed out with tincture of iodin, and packed with iodoform gauze. The abdomen is then opened, after carefully protecting the general abdominal cavity with warm, moist towels, while the woman is in the Tiedelenburg position, the adhesions are broken up, the

tubes carefully liberated and all pus and detritus sponged out, and the pelvis dried and packed with moist towels. The tubes are completely excised from the horns of the uterus by rather a free oval incision which reaches quite to the attachment of the round ligaments on the sides of the uterus,

and to the mucous membrane of the uterus within, immediately over the opening of the Fallopian tube, this opening may be slightly enlarged by a dilator. As a rule, in pus cases, the broad ligaments are so thickened and softened and are so adherent to the tubes, that a mass ligature is passed around the outer folds of the broad ligament, outside the tube, and the ovarian vessels tied off. After this, all the involved upper part of the broad ligament is removed with the tube, including the uterine insertion. Frequently it is necessary to cut through the uterine attachment of the round

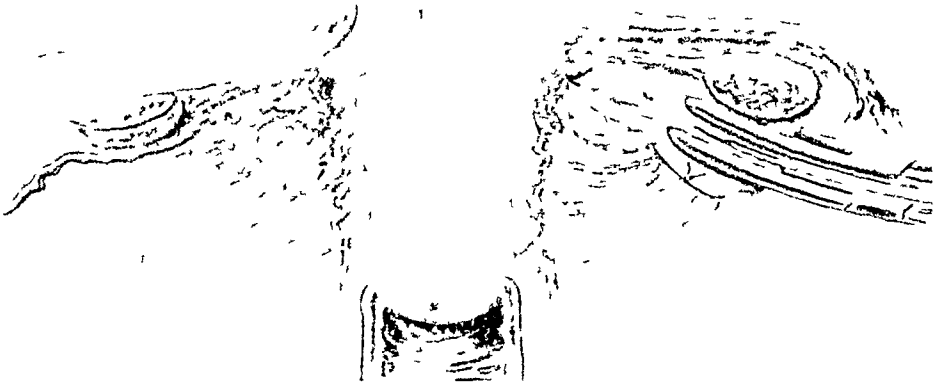


FIG. 4.—This shows the manner in which the side which for any reason will not be implanted is approached and excised.

ligament, in order to get rid of all infected tissues. Both tubes are treated in like manner. When only one ovary may be implanted, after excising both tubes, the stump of the broad ligament on the side opposite the retained ovary is first sutured to the horn of the uterus, then the implant is fixed and properly covered.

The ovaries will have been liberated in the separation of the tubes and the evacuation of the abscess cavities. If not fully liberated they should now be freed and carefully examined. Then all the degenerated part of the ovaries should be excised by cutting away, if possible, the lower unattached part of the organs. The ovarian ligament should be preserved, if practicable with its small artery and the attachments to the broad ligaments also, if it can be done without leaving bad tissue behind. This is not essential, however, as completely excised portions of the ovarian stroma may be implanted. The portion of the ovarian stroma which is left is cut in such a pattern that it will fit into the oval concavity left in the horns of the uterus when the tubes are excised. These portions of ovary should be successively drawn over, placed with their raw surface fitting into the oval concavities in the horns of the uterus, and fastened in place in the uterine walls by running sutures of No. 1 chromicized catgut all around their edges. The stumps of the round ligaments and broad ligaments are then brought into apposition with the sides of the uterus in such a way that the implanted segment of ovary is entirely covered by the serous membrane of these ligaments. This serves the double purpose of steadying and fixing the uterus in position and

## IMPLANTATION OF AN OVARY

protects the grafts from possible adhesions to the intestines or omentum. When drainage is necessary, and it frequently is in these cases, it is made through Douglas' cul-de-sac into the vagina by an iodoform gauze strip packed into the ragged cavity so frequently left in the pelvis, or by a cigarette drain, or by tubes, and the ends passed through the small puncture into the vagina. This packing or drain may be removed in from five to six days as a rule.

Maclaune, writing sometime ago in *Archives Generales de Chirurgie*, on the subject of ovarian grafts, recommended anastomosing the ovarian vessel with some others, preferably the epigastric, in doing ovarian grafting. He thinks an assured blood supply is most necessary for success in these operations. Undoubtedly he is right in one sense, for the grafts would surely atrophy and become useless without a proper blood supply. In my method, the blood supply from the uterine vessels



FIG. 5.—This shows how the stump of the broad ligament on the side not implanted is tied off and brought by sutures to the sutured horn of the uterus and made to cover over the wound and to steady this side of the uterus.

to the ovary is never, or rarely, cut off completely. But even if it is, the ovarian graft fitting directly into the walls of the very vascular uterus, soon will establish a blood supply which is quite adequate for even this organ, though it must have a rich supply of blood.

*Results of the Operation*.—More than a hundred ovarian implantations after this method have been done in the clinic at St. Luke's Hospital. I myself investigated fifty of the cases done by myself over eight years ago. My son, Dr. W. L. Estes, Jr., recently investigated ninety-three cases, including my personal cases and those done by Dr. W. P. Walker and himself. In this list of ninety-three cases, two deaths are recorded following the operation, from general septic peritonitis, the result of extensions of already far-advanced septic inflammations in the pelvis. It is not recorded whether these fatal cases had a streptococcal infection or not. It is, however, my opinion that the implantation should not be done in cases of streptococcal infection.

In only forty-five cases could we obtain complete and accurate information concerning the result of the operation.

Of the forty-five cases, twenty-two women had been pregnant before the operation, twenty-three had never been pregnant.

*Pregnancy*—After the operation four of our cases became pregnant, two went to full term and bore normal healthy children, two cases aborted at about three months' pregnancy. Dr. Thomas C. Zulick, of Easton, Pa., in a personal communication, informed me that a woman about thirty-three years of age who had never been pregnant, upon whom he did an ovarian implantation after my method, on account of complete stenosis of both tubes from a gonorrheal infection, became pregnant, and bore a healthy child at full

term. This makes five pregnancies in forty-six cases, or 10.8 per cent.

*Menstruation*—Only four patients out of forty-five failed to menstruate after the operation. These cases were 23, 28, 32 and 37 years old, respectively. The 23-year-old patient had already had two operations done on her pelvic organs. One tube and ovary had been removed. The remaining tube had a gonorrheal infection and the ovarian stroma was almost entirely destroyed by cystic degeneration. All the pelvic contents were matted together by dense adhesions, only a very small portion of ovarian stroma could be retained and implanted. This woman already neurotic and hysterical, never menstruated after the operation, she con-

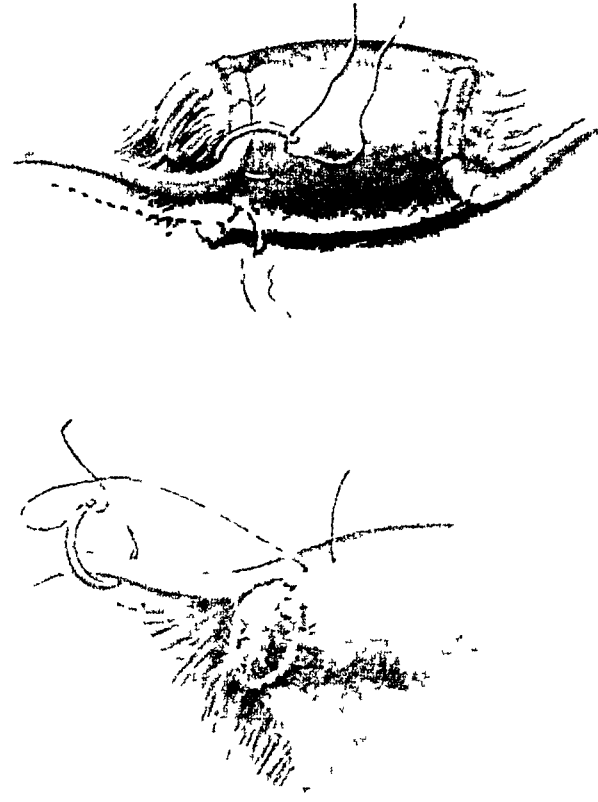


FIG. 6.—This shows the ovarian fragment implanted into and sutured to the horn of the uterus in the lower picture. The upper picture indicates how the broad and round ligaments are brought over the horns of the uterus sutured and made to cover and to protect the implant and to steady and support the uterus in the pelvis.

tinued very nervous and ailing, though she escaped the "hot flashes" and other vaso-motor disturbances which follow suddenly arrested ovulation. No very definite information except that she did not menstruate after the operation was obtained from the 28-year-old patient.

In her case, too, only a very small portion of one ovary could be retained for the implantation.

The 32-year-old patient was operated upon for a very severe tuberculous salpingitis. The peritoneal coat of the ovaries was so extensively involved that only a small portion of one of the ovaries could be retained. No nervous or circulatory disturbances followed the operation and the patient regained her health completely.

The 37-year-old patient had a very bad gonorrheal salpingitis with general

## IMPLANTATION OF AN OVARY

suppurative peritonitis within the pelvis, in which both ovaries were involved, and only a very small portion of one ovary could be saved

It appears that for menstruation certainly to continue, more than a very small portion of an ovary must be retained and implanted

*Nervousness and Vaso-motor Disturbances*—Of the forty-five cases who reported, twenty-three said "they often felt nervous," but this nervousness seemed to be ordinary occasional nervousness nearly every woman experiences and not, except in one case, the nervous storms which come in young women after removal of tubes and ovaries. One case developed symptoms of hypothyroidism about a year after her operation. None of the women reported "hot flashes" nor any of the manifold neuro-vascular phenomena

*Subsequent Physical Manifestations*—In all the women examined there was found a bulge or slight enlargement of the horn of the uterus, which received the implant, but there was no tenderness and except in four cases, there was no persistent pain

Four cases were again operated upon on account of pain. Cystic enlargement of the implanted ovary was found in three of these cases

In two of my cases which I followed up for some time, an enlargement of the implanted ovary occurred. I thought it was cystic in both cases, but it entirely disappeared in both cases and gave no trouble

*Comment*—The operation has been used at St. Luke's Hospital since 1905. As this method of implantation of ovarian stroma has resulted in pregnancy in over ten per cent of the cases, we have been able to follow several years after the operations, and itself does not seriously prolong the usual operative procedures nor add any danger to the necessary operative procedures during and after operation, it seems worthy again to be presented to the notice of surgeons with the hope that it may prove as useful in other clinics as it has at St. Luke's

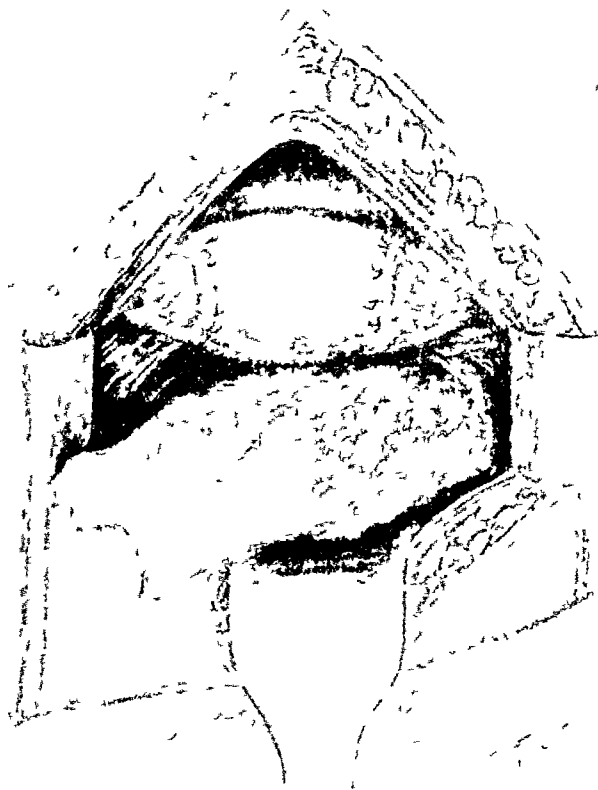


FIG. 7—This shows the appearance of the uterus and ligaments looking from above through the abdominal wound after the completion of the implantation and reattachment of the ligaments over the implants

## BIBLIOGRAPHY

- Babcock. Am J Obstet and Gynec, vol v, p 423  
 Bainbridge. Am J Obst and Gynec, 1923, vol v, p 379  
*Ibid* P 493  
 Baldwin. Am J Obst, 1902, vol xxvi, p 835

- Chalfant Surg, Gynec and Obst, 1915, vol xxi, p 579  
 Knaurer, Emil Archiv fur Gynakol, vol lx, 1900  
 Estes, W L Penna Medical Journal, May, 1910, vol xiii, p 610  
 Estes, W L The Medical Times, May, 1922, vol i, p 132  
 Estes, W L, Jr Mayo Clinic, Rochester, Minn, June 5, 1923  
 Estes, W L, Jr Surg, Gynec and Obst, March, 1924  
 Martin, F H Chicago, Surg, Gynec and Obst, July, 1908 In this article Doctor  
 Martin has reviewed and included most of the literature of the subject up to date  
*Idem* Surg, Gynec and Obst, 1915 vol xxi, p 568  
*Idem* Chicago Med Recorder, vol xxvi, p 1  
*Ibid* Surg, Gynec and Obst, 1922, vol xxxv, p 573  
 Morris, Robert J New York M J, 1895, vol lxi, p 436  
*Idem* Med Record, 1906, vol lxi, p 697  
*Idem* Am J Obst and Gynec, vol v, p 559  
 Polak Pelvic Inflammation in Women New York, Appleton and Co, 1921, p 166  
 Palmer, Dudley A Post-graduate New York, April, 1900  
 Mauclair Annuaire de Gyn et d'Obsteter October, 1900  
 Storer Boston M and S J, 1915, vol clxii, p 41  
 Tracey Am J Obst and Gynec, vol v, p 423  
 Tuffier Surg, Gynec and Obst, 1915, vol xx p 30  
*Idem* Surg, Gynec and Obst, vol xxxix, No 4, 1924

# MANAGEMENT OF BILATERAL OVARIAN DERMoids \*

By FRANK S. MATHEWS, M.D.

OF NEW YORK, N. Y.

A DERMoid developing in an ovary produces a distortion of it but no other recognizable changes. There is abundant evidence that its internal secretion continues as well as ovulation in such an ovary. Menstruation, corpus luteum formation, pregnancy and delivery at term may occur in the presence of bilateral or multiple dermoids. This suggests the wisdom, when anatomically possible, of removing the dermoid from the ovary rather than the ovary itself, especially when each ovary is affected. As a rule, one distinguishes by the eye the cystic and solid dermoid from the ovary containing it. There is a line of cleavage which is easily followed. Years ago, while doing microscopy, I was much impressed by finding a corpus luteum forming a prominence on the thinnest portion of the wall of a large ovarian dermoid cyst. In spite of the fact that the dermoid spread out the ovarian tissue until it was only 1 or 2 mm. thick, a follicle had ruptured and a corpus luteum developed in normal fashion.

The origin of dermoids is obscure. There is an interesting suspicion that they represent a development of an unfertilized ovum. The following clinical observations have some bearing on the problem of origin.

1 According to Bland-Sutton,<sup>1</sup> dermoids are never found in any other abdominal viscus.

2 They are found chiefly during the period of sexual maturity and very much less frequently in children and the aged (Askanazy).<sup>2</sup> When one is encountered toward the end of life (there are several recorded in women of eighty to ninety-two<sup>3</sup>) there is no means of determining the age at which they originated.

3 Though infrequently seen in children, yet they constitute much the commonest form of ovarian tumors in the premenstrual years. Eight ovarian cysts and tumors have been operated on by my associates and myself at St. Mary's Hospital for Children. Five of them have proven to be dermoids. These patients usually were brought to the hospital because of pain, the result of a twisted pedicle.

4 They are never congenital. This statement is based partly on the authority of Bland-Sutton<sup>1</sup> who says that he has made a thorough search of the literature and hospital records. The earliest record of ovarian dermoid that I have been able to find is that of the patient of Sant Anna<sup>4</sup> of Rio Janeiro, operated on by him at the end of the first year of life. Among the cases at St. Mary's Hospital for Children, the youngest was one operated on by me at the age of six years. I have seen several statements in general

---

\* Read before the American Surgical Association, May 4, 1925.



articles <sup>4</sup> dealing with the subject of ovarian dermoids in which it is said that they are rarely congenital but no one of these articles gives a reference to a case report

5 Ovarian dermoids are found bilateral or multiple too frequently to be explained by chance. A recent report <sup>5</sup> of 100 consecutive patients with ovarian dermoids at the Mayo Clinic showed 128 dermoids in 100 patients. In 13 per cent of the patients, both ovaries were affected.

The cases forming the basis of this paper are 6 in number. Five were observed by myself and one was the patient of my associate, Dr. Walton Martin at St. Luke's Hospital. In 4 of these patients, the dermoids were associated with pregnancy.

The first patient on whom a resection was done was a married woman, aged forty-three years who had never been pregnant. The right ovary was the seat of a large



FIG. 1—Dermoids with early pregnancy

dermoid and the left contained a dermoid 3 cm in diameter. On enucleating it an ovary was left practically normal in size and appearance. The patient was greatly pleased when told that her ovaries had not been removed. Men-

struation continued regularly for five years after the operation and was followed by a normal menopause.

A second patient was a single woman aged twenty-nine years and about to be married. A removal of both ovaries in her case would have been little short of a calamity. A dermoid of large size was enucleated from each ovary and a corpus luteum was seen in each.

The third patient came under the care of Doctor Martin at St. Luke's Hospital, November 1924, at the age of twenty-four years six months after the birth of her only child. Each ovary contained a dermoid about the size of a lemon. A bilateral enucleation was done and the bed of the tumors closed by suture. Convalescence was normal and menstruation has since been normal in time and amount.

The fourth patient was a married woman aged thirty-one years, the mother of three children. The uterus was retroverted and adherent and there had been some irregular bleeding. Though pregnancy was suspected, it seemed wiser for many reasons to remove the uterus with the dermoids. (Fig. 1)

The fifth patient was seen in consultation with Dr. Ralph Lobenstine. At the time of operation she was at about the middle of her first pregnancy. The ovarian dermoids were giving pain and were of such considerable size as to make operation seem urgent. The cysts on enucleation left the ovary much flattened out but sutures fairly well reestablished the form of the organ. Though the corpus luteum of the pregnancy was removed with the cysts, the pregnancy continued and ended with the delivery of a normal child at term. Menstruation has continued to the present time with a tendency to be profuse for the first year or two. There has been no subsequent pregnancy.

Patient six is, perhaps, the most interesting of all. She was seen by me with my

## MANAGEMENT OF BILATERAL OVARIAN DERMoids

associate, Dr Morris Smith Her last menstruation had been on August 12, 1922 The operation was performed on October 14 1922 From the left ovary a dermoid 14 cm in diameter was enucleated The right ovary contained two dermoids with diameters of 8 and 3 cm The corpus luteum of pregnancy was removed with the cysts The patient who was then twenty-four years of age, continued her pregnancy and was delivered by Dr K B Steele of a normal child at the New York Lying-In Hospital

In this connection, I might mention another patient with a unilateral dermoid She is now twenty-nine years of age and in apparent good health She gave birth to a normal child when twenty-three and has never menstruated since No symptoms, however, like those of a menopause have arisen One year ago I removed a dermoid from the right ovary There was no sign of a corpus luteum in either ovary Though one might suspect a connection between the dermoid and the suspension of the menstrual function, I am disposed to think that this was a chance association since there was no tumor in the left ovary, since other cases of single or double ovarian dermoid have shown no such effect on menstruation and since infrequent examples of cessation of ovarian function even in young women are recorded following a single pregnancy

### CONCLUSIONS

- 1 The preservation of an ovary, the seat of a dermoid, has proved a satisfactory procedure Menstruation has continued and in no case has any condition of the ovary arisen requiring a later operation

- 2 Enucleation of dermoids during pregnancy is not inconsistent with the continuance of gestation

- 3 On the basis largely of animal experiments, it has been believed that the early removal of a corpus luteum would interrupt a pregnancy Pregnancy has continued in two of the above patients whose corpora lutea were removed at second and fifth months of the gestation period

- 4 Pregnancy has not occurred after bilateral enucleation in any of the patients

### BIBLIOGRAPHY

- <sup>1</sup> Bland-Sutton Tumors Innocent and Malignant, 6th ed
- <sup>2</sup> Askanazy, M Die Dermoidcysten des Eierstocks, 1905
- <sup>3</sup> de Sant'Anna, J (Rio de Janeiro) Kyste Dermoide de l'Ovaire chez un Enfant Agee d'un An La Gynecologie, 1896, vol 1, p 213
- <sup>4</sup> Campbell, J Bilateral Dermoids of the Ovaries, Clin Jour, 1917, vol xlv1, p 286
- <sup>5</sup> Konckv, J D Ovarian Dermoids, ANNALS OF SURGERY, 1925, vol lxxxi, p 821
- <sup>6</sup> Pollack, R Proc Roy Soc Med, 1909, II Obstet and Gynec Sect, p 223

# TREATMENT OF UTERINE FIBROIDS\*

By JOHN B. DEEVER, M.D.

OF PHILADELPHIA, PA.

WITH REMARKS ON PATHOLOGY OF FIBROIDS

By STANLEY PHILIP REIMANN, M.D.

DIRECTOR OF THE RESEARCH INSTITUTE OF THE LANCKENAU HOSPITAL

THE primary consideration with regard to the subject I will discuss is should all symptom-producing fibroids be removed in the absence of grave constitutional contra-indications, or grave local disease not produced by the fibroid itself? My reply to this question is decidedly in the affirmative. I have never thought a fibroid a simple tumor, nor that, in the absence of local symptoms, it is harmless. Many of these tumors elaborate toxins which cause degenerative changes in the heart, if not in other organs as well. This fact of itself is sufficient reason for removing the tumor.

The second question is, how should the fibroid be treated, by surgery, by radiation, or perhaps by both? This question is still a moot one in the minds of many surgeons. In my own mind there is no doubt but that the removal by operation is the safest procedure.

The non-operative treatment of uterine fibroids, as I view it, is far less efficacious than the operative treatment. I cannot advocate X-ray or radium treatment for these tumors except when there are grave constitutional contra-indications to operation, then of course treatment by X-ray or radium is in order. My objections to these modes of treatment may be briefly stated. From a practical point of view, the length of time necessary to accomplish the cure makes it expensive, and furthermore, except in very experienced hands, the treatment is attended by more risks, more complications and more unfortunate sequelæ than is operation. The risk of destroying the function of the ovaries so important to the well-being of the patient is not by any means trifling. The toxicity caused by either radium or X-ray, particularly by the high voltage machine, must also enter into consideration. It often produces most distressing symptoms which are not always easy to relieve and has been known to incapacitate the patient for an indefinite length of time. The deformity of the skin at the site of the application, either in the shape of discoloration or irritation is not at all inviting. Furthermore, the pathological tissue which remains behind, and the future of which cannot definitely be forecast may be a matter of serious import. Also in the presence of marked anæmia the blood does not return to normal as promptly as after operation because bleeding is not so promptly checked. Likewise the blood changes after radiation are not as yet well understood. In a word, this treatment has

---

\* Read before The American Surgical Association, May 4, 1925

never appealed to me for operable fibroids. On the other hand, consider the low mortality of the operation, which in a recent series of 502 cases was 2.1 per cent and that the ovaries, if not diseased, can be left, and the woman is minus the tumor and has nothing to dread in the shape of degenerative changes in a questionable residuum. These facts, it seems to me, are good enough arguments in favor of surgery without going into further details.

I wish I could influence the gynecological surgeon to think as I do with respect to this question. Perhaps he will in the future when the gynecologist as a specialist will have been superseded by the abdominal surgeon, who will carefully look after all abdominal ills. I wish here emphatically to dispel the illusion that fibroids may and sometimes do decrease in size after the menopause. In my experience I have found the opposite to be the rule.

The third question, after operation is

once decided upon, is whether to do a total hysterectomy, a subtotal or partial hysterectomy or a myomectomy.

The objections to promiscuous myomectomies are that consecutive and secondary bleeding after the operation is not uncommon, that infection is more likely than after the usual fibroid operation, and since the fibroid uterus is very often a sterile uterus, there can be less objection to its removal. In the event of either hemorrhage or infection, the subsequent disability is greater than after hysterectomy.

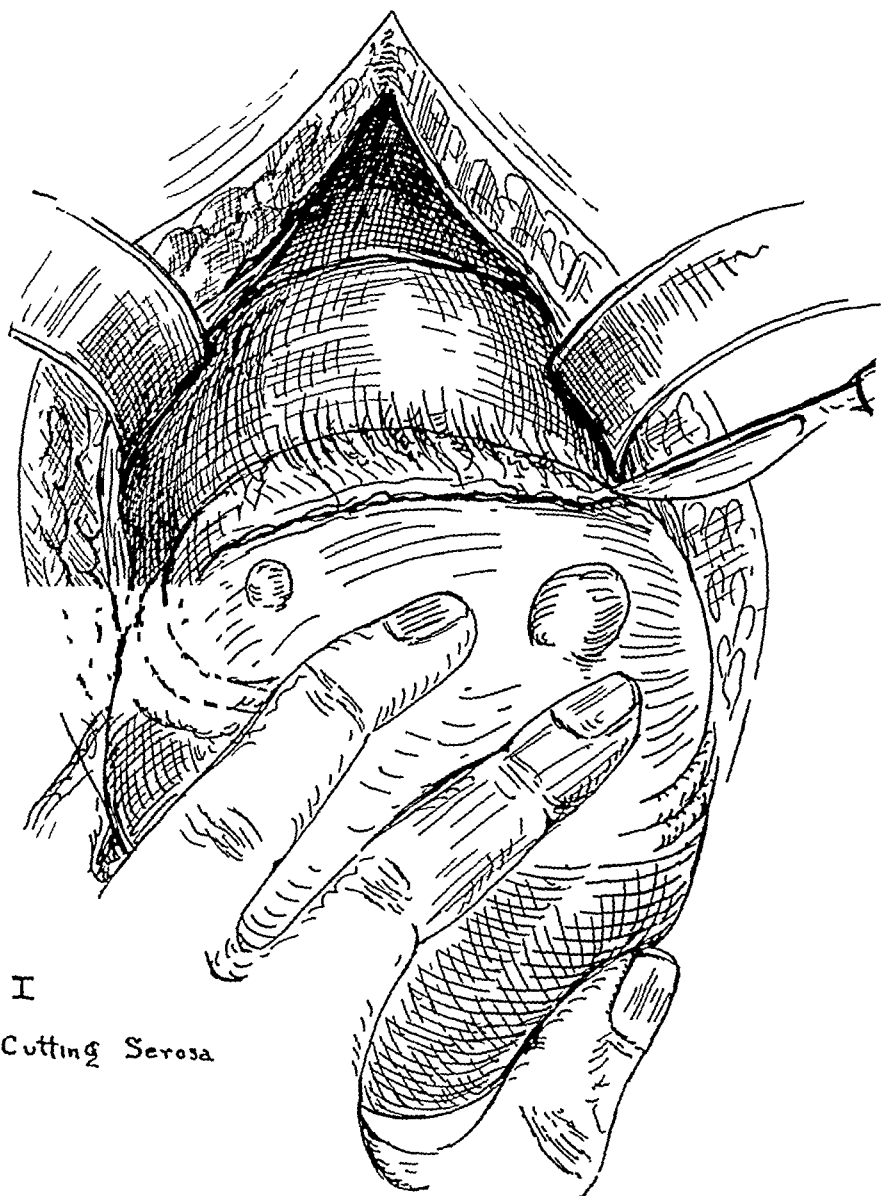
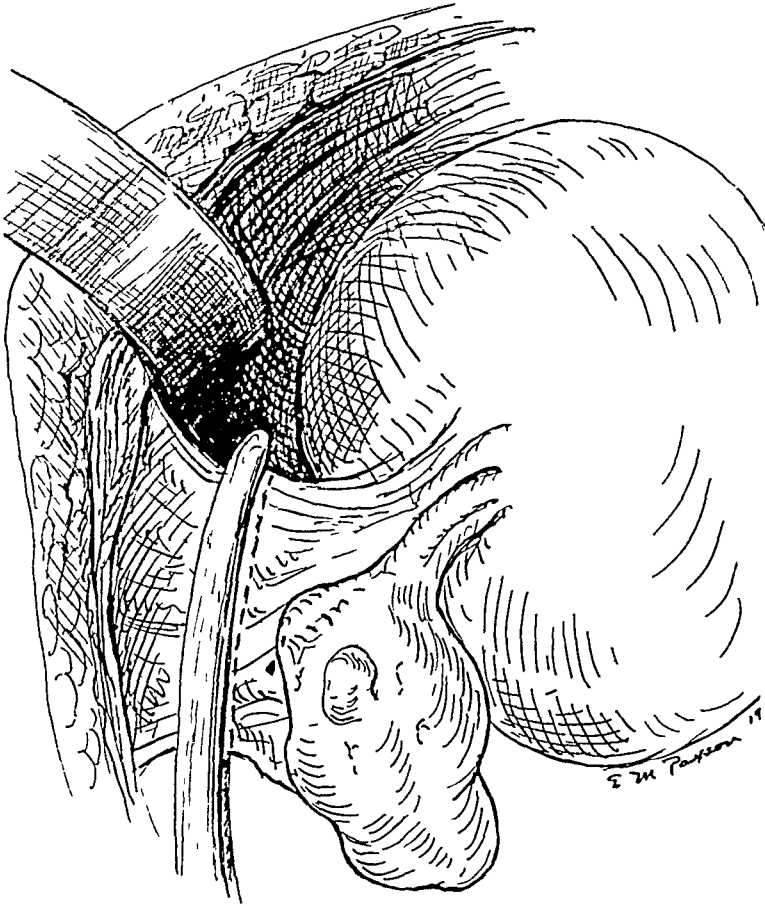


FIG. 1.—Removal of fibroid. Cutting serosa.

The type of operation depends upon the size of the fibroid, its location and the complications present

Myomectomy is especially indicated in single isolated fibroids, in pedunculated fibroids, located so they can be readily excised or shelled out with little if any injury to or loss of uterine tissue. The interstitial tumor, as well as the fibroid located within the broad ligaments, can often be removed as an isolated tumor, but one must exercise care in the selection of the case



II

Clamp on Left Broad Ligament + Round Ligament  
--- Cut here

FIG 2 —Removal of fibroid. Clamp on left broad ligament and round ligament

Myomectomy is to be especially considered as the operation of choice in the young woman. The general contra-indications to this operation are extreme anæmia, inflammatory disease of the uterine appendages, multiple tumors, also a large interstitial tumor, if for no other reason, because of the difficulty of closing the cavity in the wall of the uterus so as to be perfectly sure that bleeding will not occur.

In submucous fibroid, myomectomy has a limited field. The operation can be only judiciously determined by abdominal hysterotomy. Incidentally I may say I rarely make a vaginal hysterotomy for submucous fibroid, for the following reasons. This route cannot possibly be made aseptic, so that there is greater risk of post-operative infection, one has not the same control of bleeding as in the abdominal operation, and unless the vagina is abnormally large one cannot manipulate with the same degree of ease and certainty as in the abdominal operation. Myomectomy should leave a normal uterus, plus the presence of ligatures and sutures. While I never promise a patient that

## TREATMENT OF UTERINE FIBROIDS

I will do a myomectomy, I always give the assurance that if possible I will do so. Neither the gynecological nor the abdominal surgeon can definitely settle this question until he sees and palpates the uterus through an open wound. This is the only means of revealing the truth, no matter how much diagnostic skill one may have or may think he has.

In describing the operation of hysterectomy I classify the different portions of the uterus as fundus, body, supra-vaginal and infra-vaginal cervix.

In the simple fibroid where the cervix is normal and the patient has not reached the menopause, subtotal or partial hysterectomy (amputation through the supra-vaginal cervix) is the procedure of choice.

The type of hysterectomy depends upon the age of the patient, the condition of the cervix and of the uterus, the size and site of the tumor, its topography and the complications present in the shape of diseased adnexa, entanglements with neighboring organs, etc.

In doing a subtotal or partial hysterectomy, the first thing is to deliver the fibroid, pulling it upward and backward, thus making the broad ligaments taut as well as exposing the bladder, then making a transverse incision of the peritoneum just below its reflection from the uterus onto the bladder, when with a small piece of moist gauze the peritoneal reflection with the bladder is carried downward and forward beneath the pubis displacing it, as well as the terminal portion of the ureters out of harm's way. The left broad, including the round ligament to the pelvic or the uterine side of the ovary,

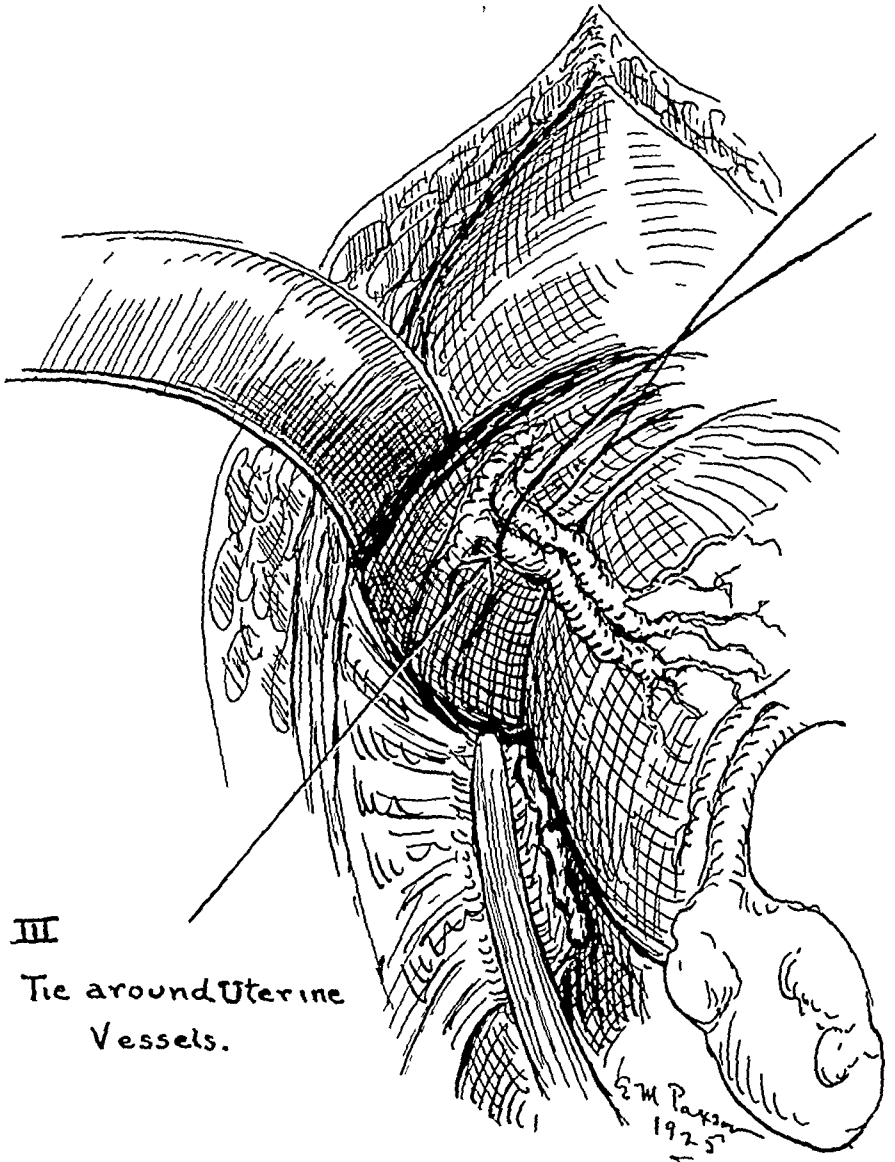
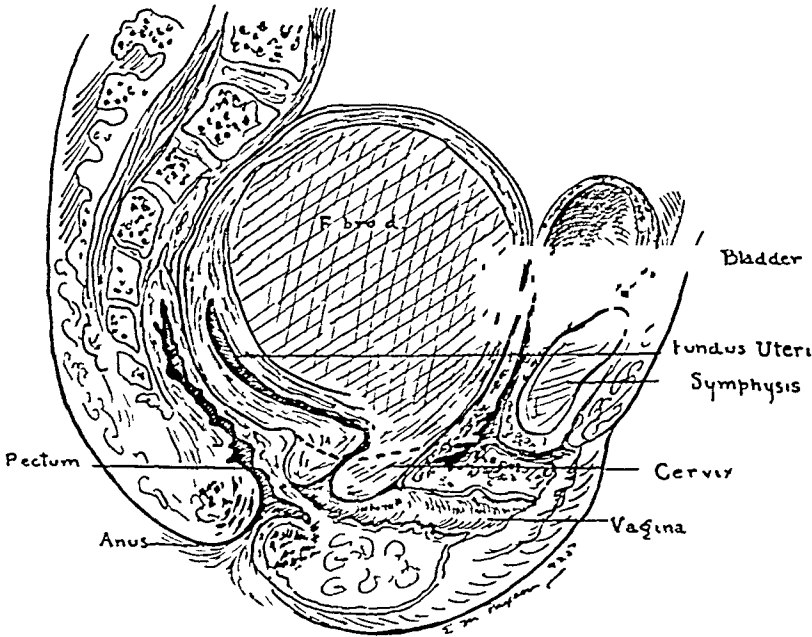


FIG 3 —Removal of fibroid Tying off uterine vessels

depending upon whether or not the ovary is to be removed, is then grasped with a Spencer-Wells forceps the ligament cut and the forceps with point downward is pushed down into the pelvis. This latter manœuvre exposes the uterine vessels which are then clamped with hæmostatic forceps and divided. The same thing is done on the right side, and the supra-vaginal cervix is then amputated, making a V-shaped incision. The cervical canal is next sterilized with the actual cautery, the uterine arteries tied and the stumps of the broad ligament transfixed, tied and sewn into the wedge-shaped cavity



#### IV Sagittal section through pelvis

Showing V-shaped amputation through cervix---

FIG 4—Removal of fibroid. Sagittal section through the pelvis showing V-shaped amputation through cervix

of the cervix. The final step of the operation is bringing the reflected serosa over the cervical stump and sewing it to the serosa of the posterior surface of the supra-vaginal cervix.

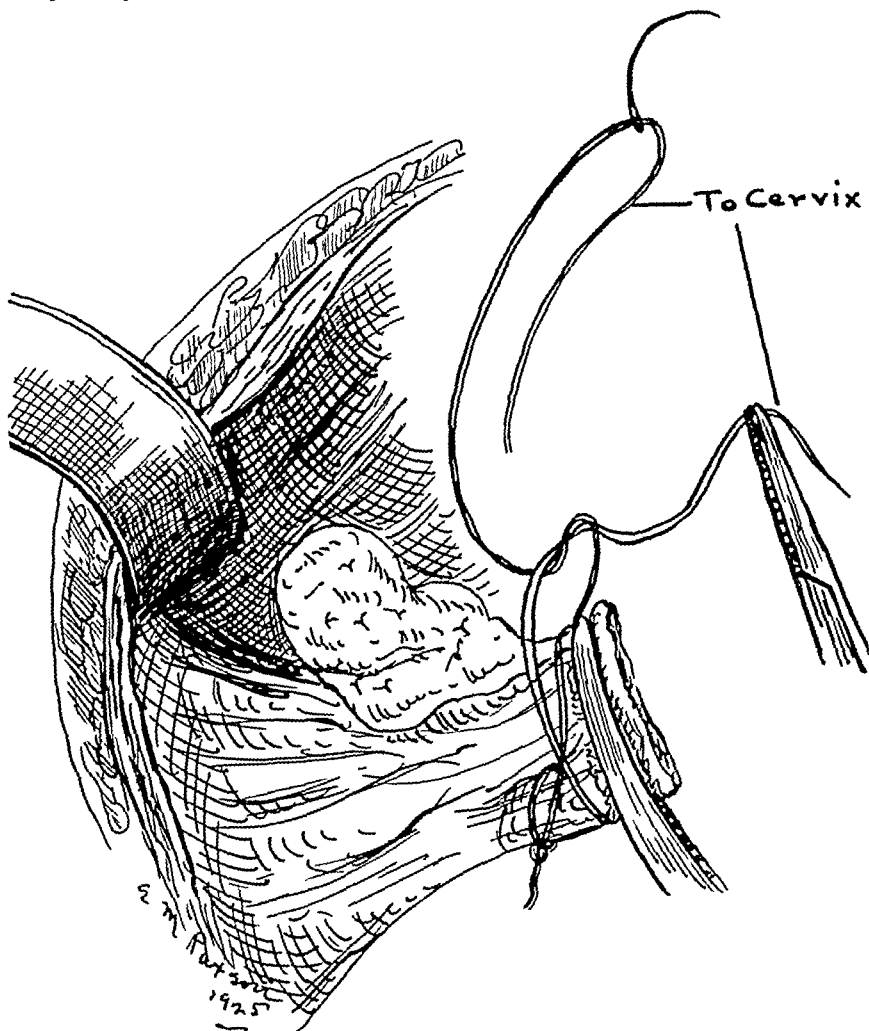
This type of operation I believe to be in all respects the best method of making a subtotal or partial hysterectomy. I admit

greater care is perhaps required in controlling the bleeding, than in the operation more commonly practiced, but after the operation is completed the supra-vaginal cervix is suspended and anchored thus permitting little, if any, chance for future prolapse. In the more popular operation the supra-vaginal cervix is not firmly anchored, in fact it is suspended in hammock fashion, and with this there is a greater risk of future prolapse. I believe also that in the method I describe, the distribution of the intra-abdominal pressure is better. The location of the fibroid will influence the operator in making his attack, whether anteriorly, posteriorly or laterally. When the fibroid grows laterally, from the supra-vaginal cervix, or from the side of the body of the uterus low down and between the layers of the broad ligament, the incision is made in the anterior layer of the ligament and the tumor enucleated from before backward and below upward. This reduces the chances of injury to the ureter, in fact the ureter should always be exposed and kept in sight. This also is the proper attack when the fibroid is incarcerated in the true pelvis between the layers of the broad ligament.

## TREATMENT OF UTERINE FIBROIDS

When the fibroid grows from the fundus of the uterus retroverted and incarcerated in the true pelvis, after dividing and reflecting the peritoneal covering where it passes from the uterus onto the bladder, the supra-vaginal cervix should be cut across, the uterine arteries clamped by grasping the supra-vaginal cervix with the strong Vulsella forceps. Making traction upward, when with the aid of two fingers carried beneath the fibroid the tumor is delivered. The delivery may in some instances be facilitated by bisecting the fibroid and deliver-

ing one-half at a time. In the presence of a strongly adherent meso-sigmoid or sigmoid concealing the tubes and ovaries, diseased or not, as the case may be, amputation of the supra-vaginal cervix from before backward is the best method of attack as it presents the least danger of injuring the ureters, the meso-sigmoid or the sigmoid, and is the most satisfactory way of dealing with diseased uterine appendages. I could go more into detail in the tech-



V

Tying off Pedicle (Ovary retained),

FIG 5 —Removal of fibroid Tying off pedicle

nic of the removal of the fibroid tumor, but I take it that the operator's ingenuity plays the most important role in the technic. In a series of 336 operations there was 23 per cent mortality.

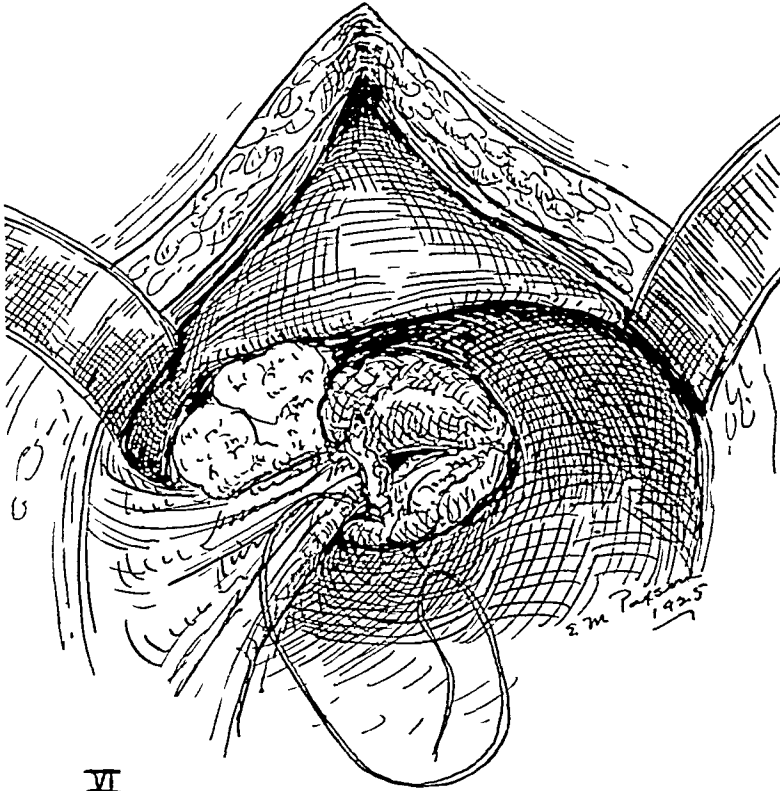
For fibroid tumors developing during or after the menopausal process, particularly when the condition of the cervix is questionable and there is reason to suspect commencing degenerative changes in the uterus, total or complete abdominal hysterectomy is the operation of choice.

The type of total abdominal hysterectomy I prefer is, after separating the bladder, tying off the broad ligaments and the uterine arteries, and exposing the supra-vaginal cervix to free it down to the vagina, the upper portion of



which is also freed far enough down to allow the application of the right-angled clamp which is applied close to the free end of the vaginal cervix, which is pushed well upward before putting on the clamp. The vagina is amputated above the clamp with the cautery knife, thus rendering the vaginal stump sterile. The vagina is then closed with a continuous chromosized catgut suture before removing the clamp and again reinforced after the clamp has been removed. This makes a purely intra-peritoneal operation, no communication having been made with the vagina. The operation is terminated

by sewing the stumps of the broad ligaments to the vaginal stump, and sewing the reflected serosa to the posterior surface of the extreme upper end of the vagina. I may say this is perfectly satisfactory and as safe as a subtotal or partial hysterectomy if the necessary care to control bleeding and avoid injury of the ureter is taken. In the last series of hysterectomies in 166 cases the mortal-



## VI

### Sewing Pedicle to Cervical Stump

FIG. 6—Removal of fibroid. Sewing pedicle to cervical stump

ity was 18 per cent. One must, of course, be very sure of having controlled all bleeding, particularly of the para-metric connective tissue severed in freeing the supra-vaginal cervix and the vagina. However, one can be master of the situation by making traction on the vaginal stump, grasping it and lifting it up with a pair of Allis' forceps, and at the same time having the broad ligament stump held taut, when bleeding points are easily seen, especially if the sterile Cameron lamp is used. In order to remove any doubt about the ureter in tying the severed uterine artery just after it has crossed the ureter, the ureter can be exposed in the fold of the broad ligament and traced to its entrance into the bladder, which is very easily done. If all oozing has not been arrested, before the reflected vesical serosa is sewn to the serosal covering of the posterior surface of the upper end of the vagina, a hæmatoma will form and later may become infected on

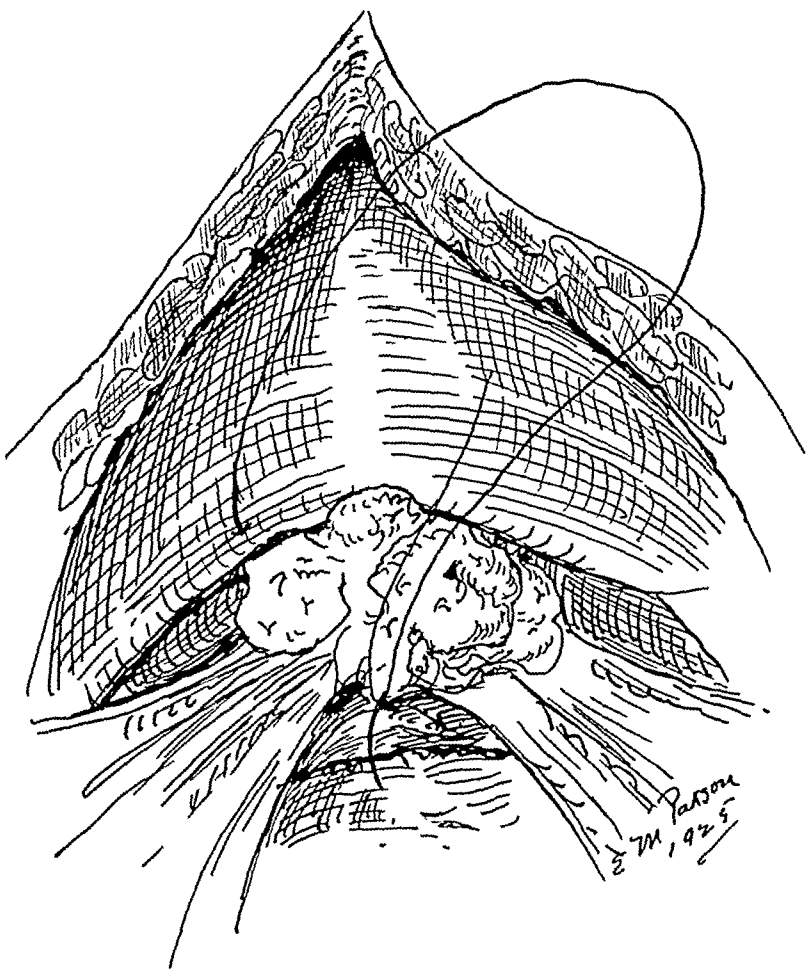
account of the proximity to the large bowel. This may result in abscess and necessitate incision and drainage through the vagina.

The greatest objection to the complete operation is that it foreshortens the vagina. This can be minimized by applying the right-angled clamp as high as possible. Prolapse of the vagina after this operation is very rare.

I have not said anything about vaginal hysterectomy, which I occasionally perform, because it is so seldom indicated in uterine fibroids.

The accompanying illustrations show some of the unusual positions of fibroid tumors, also some of the complications encountered, which necessitates modifications from the usual operative procedure.

*Remarks on the Pathology of Uterine Fibroids*, by STANLEY PHILIP REIMANN, M.D.—The gross pathology of position is of exceptional importance in fibroid tumors of the uterus since much of the symptomatology and treatment depends upon the position of their growth, that is, whether from the fundus, body or cervix of the uterus, whether anterior, posterior or lateral, or in the broad liga-



## VII

### Approximating Ant. Bladder Serosa to Post. Serosa (behind the cut edge)

FIG. 7.—Bring anterior bladder mucosa to posterior bladder mucosa

ments, and so on. Nevertheless, in this commonest of tumors we are confronted with many questions in what might be called the pure pathology which are still unanswerable. The first and foremost is necessarily the fundamental question of all tumors: what factors determine and control their growth? Since however, this general question cannot be answered at present, it may be well to discuss a few peculiar to fibroids. We know that they occur chiefly between the ages of thirty and forty years, and practically never before puberty although Leopold claims that he discov-

ered the nidus for the growth of fibroids in uteri before puberty, a statement which has not been verified nor is agreed to by most other observers

Their point of origin is under dispute. Some fibroids often contain structures other than the usual smooth muscle and connective tissue, it is thought by many that they are definite and very beautiful examples of origin from misplaced germinal tissue. Others, probably with more justification, believe that the point of development of myomas is from the muscle in the very smallest arteries, a conclusion derived from the study of very young myomas in which this relationship could possibly be traced and also helped by the fact that the uterine muscle itself is derived from blood-vessels. Ac-



FIG 8 —Uterine fibroid (calcareous) Both tubes and ovaries

## TREATMENT OF UTERINE FIBROIDS

cording to others the primary development of myomas is from small swellings detectable in the muscular strands of the uterus. On the other hand, still others believe there is a gradual transition of normal to myomatous tissue and that the isolation as to space is secondary. Perhaps, as Cohnheim has suggested, the germinal centres which develop into the uterine musculature, that is particularly from blood-vessels, are not utilized normally, but Ribbert thinks there are atypical cell groups occasionally encountered in the uterine wall, and that these furnish the starting point of myomas. Some have claimed that they found such minute myoma cell centres, whereas others have found vascular buds which they believe were surrounded by undifferentiated myogenic cells. Still others believe that myomas begin from changes in the uterine musculature itself, the earliest of which is swelling in the

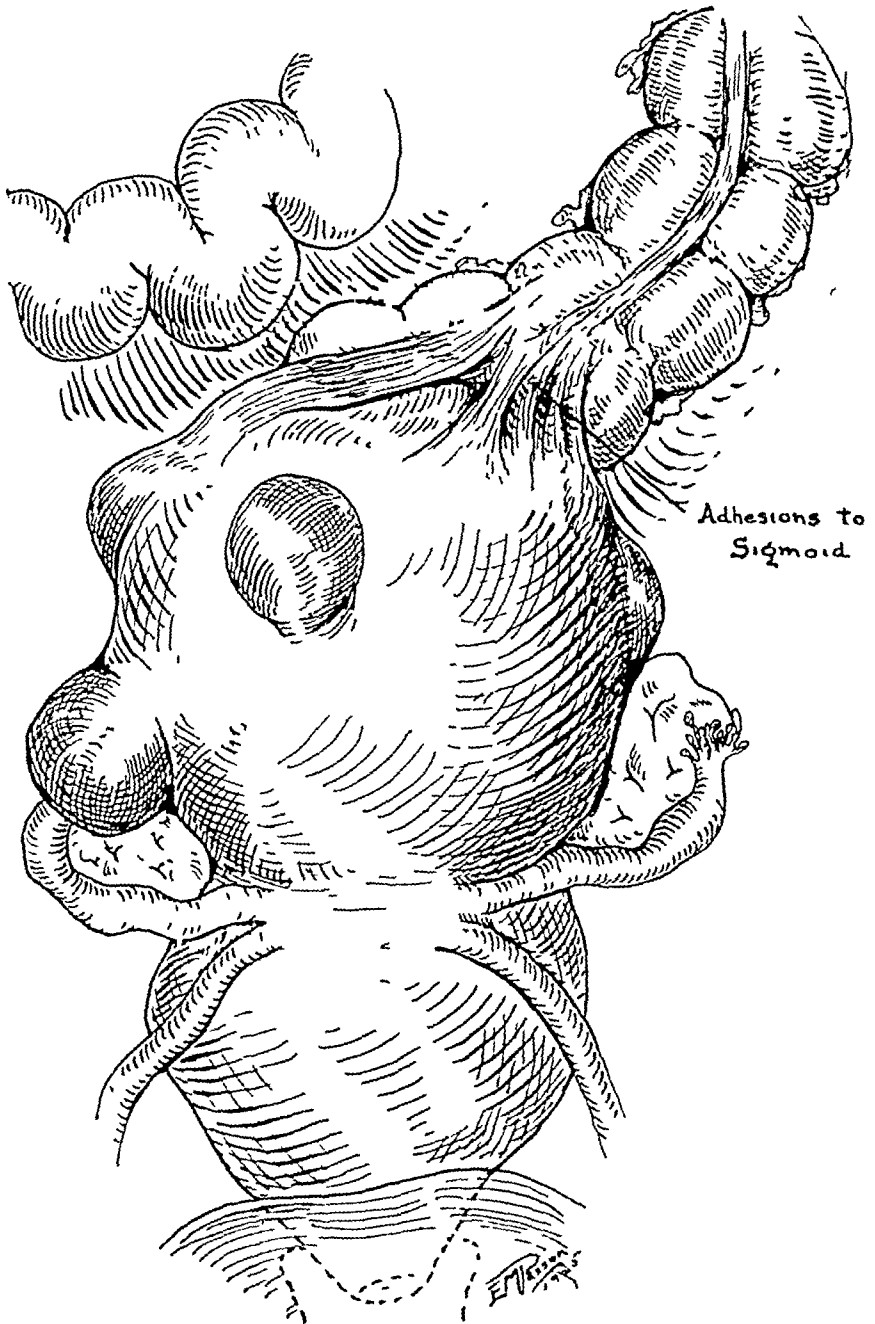


FIG. 9.—Fibroid showing adhesions to sigmoid

interlacing muscle fibres. The fact, as previously mentioned, that myomas practically never occur except during the period of adult sexual life seems to lessen the importance of the germinal centre origin theory. However, since normal growth of the uterus is stimulated at the time of puberty it may be that some germinal centres are stimulated to abnormal growth. Many believe that uteri showing malformations or arrested development are especially subject to myomas. In fact myomas are sequelæ to developmental imperfections

These tumors therefore occupying any position in the uterus, or even in the broad ligaments, are typically composed of fibrous tissue and smooth muscle, as a general rule, the smaller the tumor the more muscle tissue, and the larger, the more connective tissue. The submucous tumors are very apt to be softer than the subserous variety. We have seen uterine inversion, also spontaneous expulsion as the former became more and more distinct from the uterus being attached by a pedicle which finally was detached from the uterus. We have seen torsion of the pedicle cause total necrosis of such a

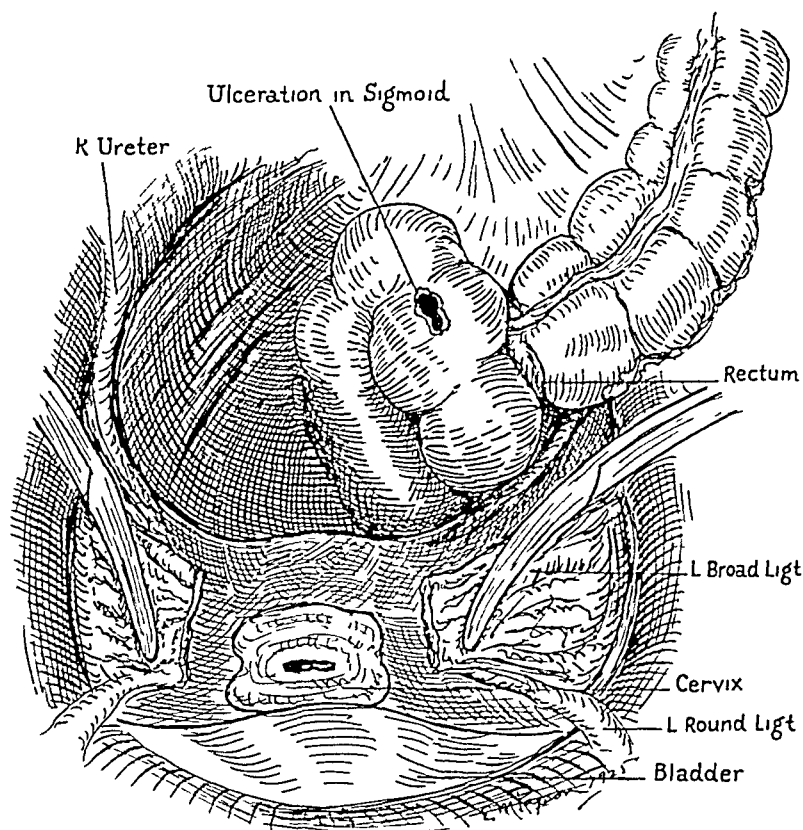


FIG 10 —Diagram showing ulceration in sigmoid from calcified mass

broad ligament adjacent to the uterus. Distortion of the tubes, ovaries and compression of the cervix, displacements and flexures of the uterus, adhesions and so on, are very often determined by position and the numerous and frequent secondary changes to which they are subject.

Adenomyomas have been encountered in this series of cases rather sparsely, but two in the entire group. There is no particular comment which we can make upon them.

The secondary changes which we have encountered have run the gamut of most of those described, such as passive congestion and oedema, inflammatory oedema, suppuration, necrosis, calcification and the frequent hyalinization. Fatty degeneration and necrosis of muscle fibres were fairly frequent in focal situations. These changes are often said to make myomas decrease in size from disappearance of the muscle elements, the fibrous parts remaining

myoma. In some of the myomas which we have encountered coming from between the layers of the broad ligaments, it is quite probable that the pedicle which the myoma possessed at one time, had atrophied and made it appear as though the tumor had developed independently. However, intraligamentary myomas may grow from the muscular portion of the

The question, however, of the relative amounts of muscular and fibrous tissue may be approached from several angles. The tumor may have originally contained considerable muscular tissue which atrophied and allowed the connective tissue to remain. On the other hand, fatty degeneration and necrosis of the muscle may lead to stimulation of the fibrous tissue into a sort of granulation tissue which will increase the fibrous tissue, and the tumor be composed of both fibrous tissue of neoplastic origin and fibrous tissue of inflammatory origin. A predominance of fibrous tissue is possibly related to

a disproportionate development of the vascular supply. The more sensitive muscle tissue cannot maintain its growth, whereas the connective tissue can and does. In such cases, however, the connective tissue is very apt to be hyalinized. It is apparent that this is not a cicatrization process, although curiously enough and illogically enough, attempts have been made to compare it to so-called

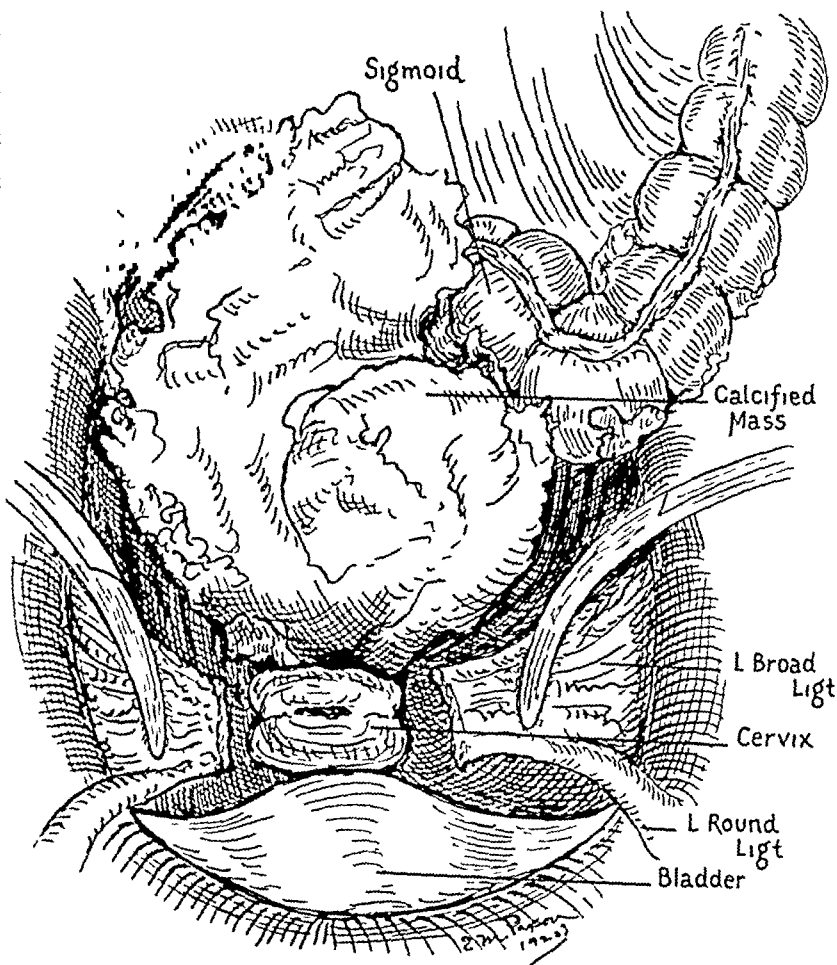


FIG. 11—Position of calcified mass

scirrhous atrophy of the breast! It is, of course, recommended that special stains be used when any of these questions are to be answered in particular tumors. The van Gieson stain in our hands has given fairly good results. This in spite of the theoretical points by which smooth muscle and connective tissue may be differentiated when stained by routine dyes.

Myomas are said to both enlarge or diminish in size during pregnancy. In the individual case this may be due to poor blood supply, to pulling and displacement of vessels, etc. Necrosis of a myoma during pregnancy occurred in one of our cases. Among the cystic myoma encountered, the changes were due to liquefaction in the centre and the formation of cavernous-like spaces without true linings from fatty degeneration and necrosis of muscle fibres. A lymphangiectatic myoma was encountered, and several that had large

telangiectasis Hemorrhage causing the formation of cyst-like spaces was fairly common Calcification was quite common, from small focal areas to complete transformation into a "calculus" as illustrated in Fig 11

Among these specimens two of primary sarcoma were encountered, both diagnosed grossly and histologically, and both proved their malignancy by later metastasis Perhaps we may add a word as to the use of a pathological term The word "degeneration" is quite often used, "transformation" or

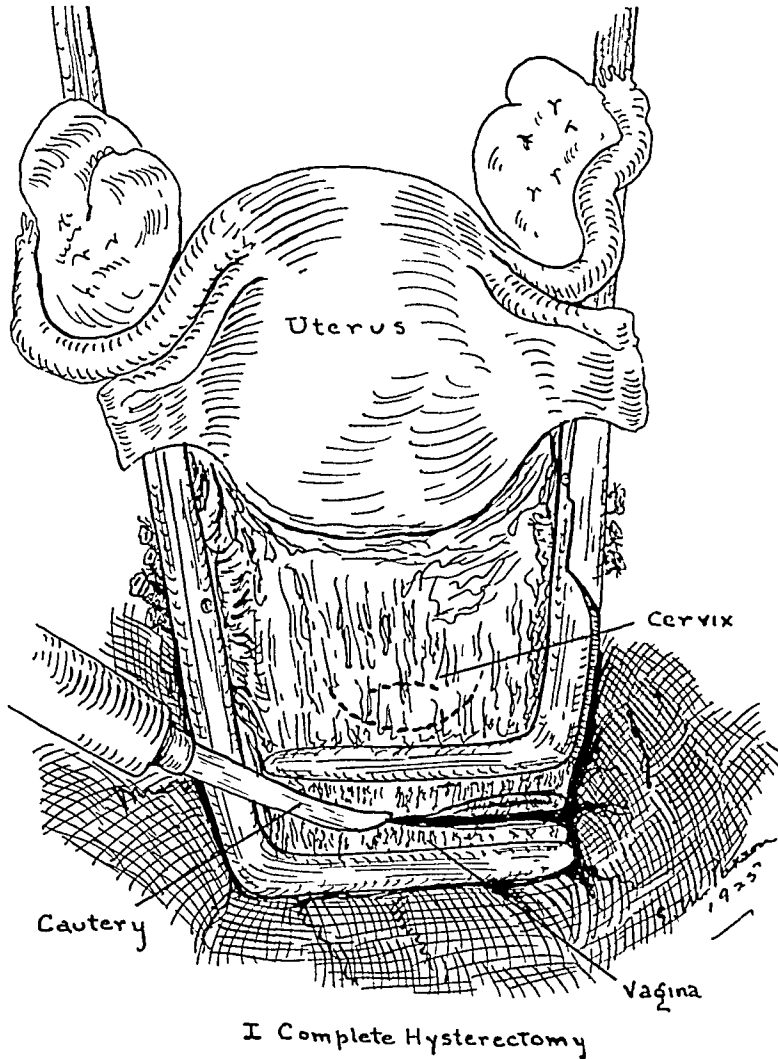


FIG 12—Complete hysterectomy Cutting through the vagina

"metaplasia" may also be used but not interchangeably, as the following argument will show As myomas grow, they may not produce typical myoma tissue but sarcoma cells the shape of which differs more and more from that of muscle cells The nuclei become thicker and shorter, ovoid, polymorphous sometimes gigantic, frequently hyperchromatic, and show much direct and indirect division The cells become more crowded with less interstitial substance and are shorter and plump

The presence of larger numbers of giant cells is apparent, and constitutes good evidence of sarcoma Finally all similarity to muscle cells is lost This transition to sarcoma is sometimes focal in one place, or in many places, or everywhere in the myoma Perhaps it first begins in one or several places and then spreads throughout the entire myoma The sarcoma cells are then the lawless aftergrowth of muscle cells and consequently it is not metaplasia but degeneration According to most observers, this type of sarcomatous degeneration of the muscular components of a fibromyoma is the most frequent form of sar-

coma. Probably the best name for such a tumor is "sarcomatous myoma" which term hints at the sarcomatous degeneration underlying the process. But the fibrous components of a fibromyoma may also give rise to a sarcoma generally of the spindle cell, round cell or myxosarcoma types. In our cases, metastases unquestionably occurred by the blood channel for there were nodules in the lungs in the liver, and in one of the patients a nodule rapidly developed in the thyroid gland. The actual percentage of myomas which

become sarcomatous is quite difficult to decide for the same reason that many other questions of percentage are difficult to decide, as for instance, the number of cases of gastric ulcer which become gastric carcinoma. The reason is that we do not know exactly what was there before the tumor was removed nor can we tell what would have happened if the tumor had been allowed to remain and the surgeon had not removed it with his knife.

## II Closing Vagina

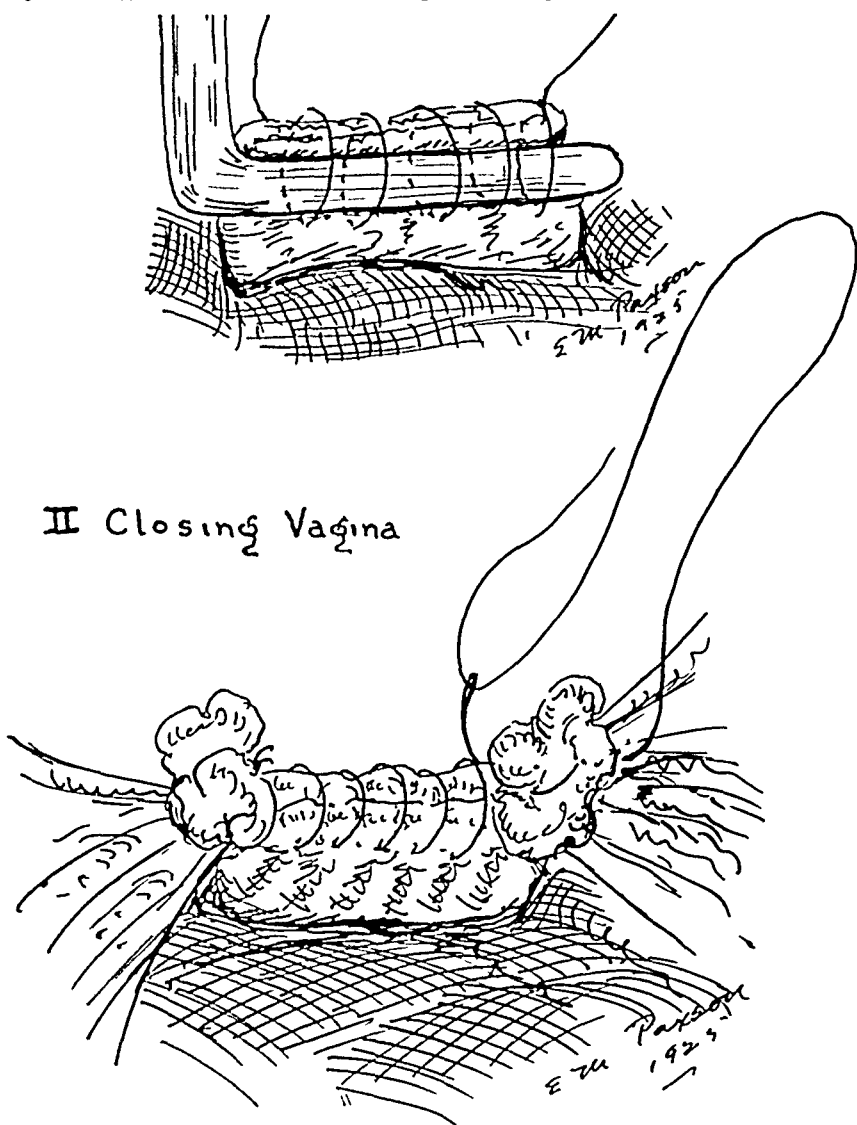


FIG. 13—Closing vagina

Careful studies from many regions of fibroids have shown that a considerable number yield isolated histological fields which are difficult to distinguish from sarcoma; that is, a single histological section will give all the appearance of sarcoma when the gross appearance is decidedly against it. This is not rare, but in our opinion the differential diagnosis in any one given slide between myoma and sarcoma is so difficult with few exceptions that the histological examination is only a part of the diagnostic data. Statements that from 1½ to 2 per cent of myomas are in reality sarcomas are quite common in the literature, but percentages such as 10 per cent (Warnekross) are much too high and are probably based on insufficient data as suggested above.



We have examined two specimens which had been treated by X-ray and radium sometime previous

The changes which we found could in no way be interpreted as characteristic of this form of therapy. The results of X-ray and radium therapy in malignant tumors, especially carcinoma, have been adequately described and seem to be, at least at certain stages after treatment, fairly characteristic. We have found this especially true in tumors of the breast of which we have received quite a few at varying intervals after X-ray treatment. The changes were sufficient to make one say that the breast had probably been X-rayed before surgical removal. In these fibroids, practically all that could be found was that the muscular tissue was conspicuous by its absence, and the connective tissue in such sections as we took from various parts of the tumors, showed considerable hyalinization. The endometrium was atrophic in part, but was shaggy toward the fundus. We can by no means say that the hyalinization as observed in the connective tissue was due to X-ray or radium therapy, for hyalinization is so common in any of the myomas that it is nothing characteristic.

On the other hand, from the point of view of X-ray and radium therapy, disease of the tubes and ovaries was found in fully half of the cases (255 in 525) in degree varying from simple hydrops of the tubes to severe acute diffuse suppurative inflammation, from mere fibrosis of the ovaries which was normal for the age of the individual, to larger or smaller cysts of various varieties, and acute and chronic inflammatory conditions of various degrees. The difficulties of clinical diagnosis in these cases appeal to the pathologist and in view of the uncertainties so often attending X-ray and radium results, it would seem wise to take this matter of extra-uterine disease into very careful consideration as illustrated by a patient who was admitted to the hospital after radium therapy for bleeding. A huge pelvic collection of pus was evacuated through the vagina and a fecal fistula was soon established. Death from infection took place some two weeks later, and at autopsy most of the uterus, the left tube and ovary, and a large portion of the sigmoid had disappeared into a soupy grumous mass. Nor is this an isolated experience in our own autopsy work, and reiteration of this danger should be sufficient as warning without further illustrative cases nor quotations from other pathologists.

On the other hand, death following operation for fibroid of the uterus is such an uncommon occurrence, and when it does happen, can usually be correlated to an unforeseen accident such as pulmonary embolism. This appeals to the pathologist who knows that when the specimen is removed with few exceptions of sarcoma, he has the entire pathological process in his own hands. Finally in the study of the patient's return to our follow-up department the practically universal report has been, "all is well."

# TREATMENT OF UTERINE PROLAPSE AND RECTOCELE BY CLOSURE OF THE POUCH OF DOUGLAS<sup>1</sup>

(JONES-MOSCHCOWITZ)

By JOHN HOMANS, M.D.

OF BOSTON, MASS.

THE operation to be described is based upon the procedure advocated in 1912 by Dr. Alexis V. Moschcowitz<sup>1</sup> for the cure of rectal prolapse. Doctor Moschcowitz demonstrated that true prolapse of the rectum was associated with a remarkably deep pouch of Douglas, which permitted intra-abdominal pressure to force the anterior rectal wall downward through the anal canal. Having shown that the

condition was in fact a hernia, he advocated and successfully practiced an intra-abdominal closure of Douglas' pouch as the most effective means of obliterating the neck of the hernial sac. Some years later in 1916 Dr. Daniel Fiske Jones<sup>2</sup> published a paper in which he reiterated the value of this procedure and showed how

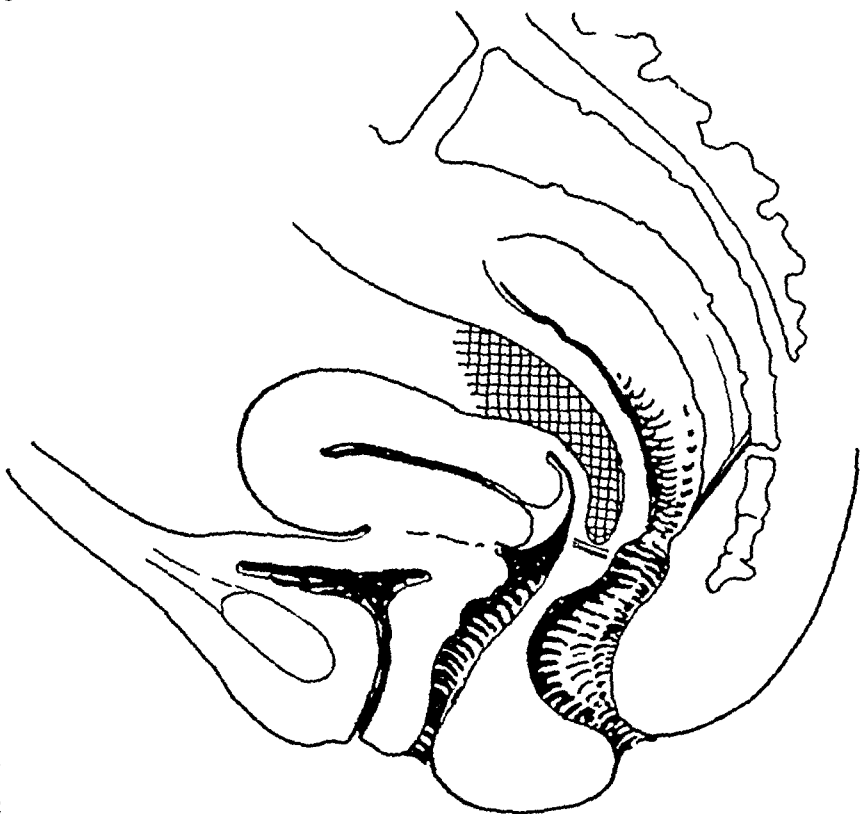


FIG. 1.—Diagram representing a normal pelvis. Note relations of the pouch of Douglas. The pelvic fascia between rectum and uterus marking the low point of the pouch is represented as a raphe.

logically the principle employed could equally well be adapted to the treatment of uterine prolapse and rectocele. Neither surgeon made claims for an originality for which both undoubtedly deserve credit.

Many operations for prolapse take into consideration the point of view which regards downward displacement of the uterus as a true herniation, but none so far as I know, employ closure of the deep cul-de-sac as a major or even integral part of the procedure. Dr. John G. Clark<sup>3</sup> speaks of the value of closing Douglas' pouch in the vaginal operation for rectocele and, on

<sup>1</sup> Read before the American Surgical Association, May 4, 1925.

rare occasions, in the course of the abdominal part of an operation for prolapse. He gives credit to Doctor Moschcowitz and Dr. L. Frank<sup>4</sup> for emphasizing the importance of such a step. I find an allusion to this principle in Graves' Text Book of Gynecology.<sup>5</sup> I know, however, of no published study of the Moschcowitz closure of Douglas' pouch as advocated by Doctor Jones for the cure of rectocele and prolapse of the uterus. For this reason

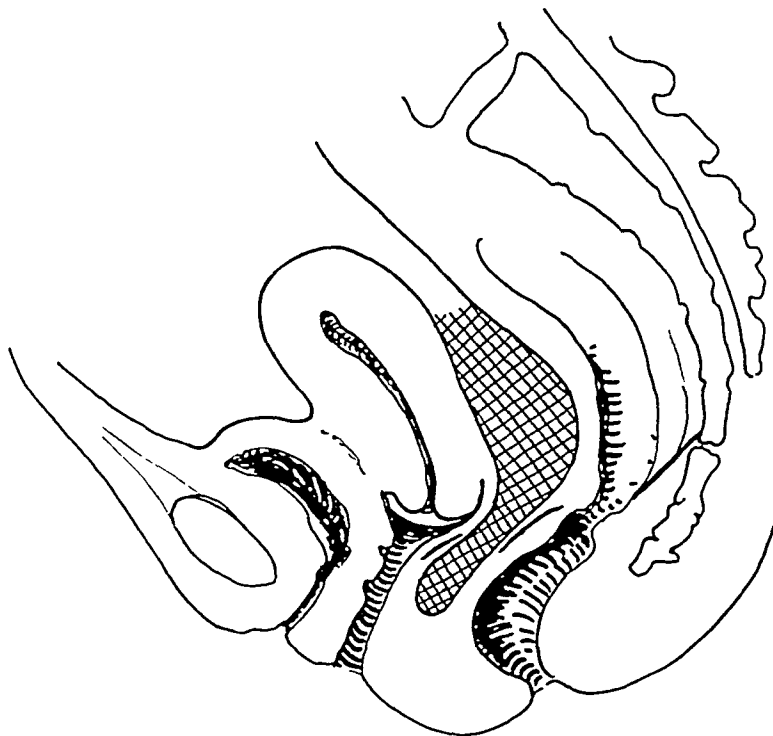


FIG. 2.—Diagram representing an abnormally deep pouch of Douglas. The condition suggested might be congenital or acquired.

I feel justified in offering the following account of the operation as I have practiced it and of its results under the various circumstances for which I have used it.

To review the pathologic anatomy upon which the operation is based the following diagrams may perhaps serve. In Fig. 1 the normal pelvic relations are shown, the pelvic fascia closing the cul-de-sac in a blunt

point between the rectum and uterus and at a level a little below that of the cervix.

Figure 2 shows a deep pouch, due, primarily perhaps to a congenital defect or lack of strength in the pelvic fascia. It is easy to see how this condition may lead in either sex to rectal prolapse and in females to rectocele.

Figure 3 suggests the formation of a rectocele, the anterior rectal wall pressing across the deep cul-de-sac into the posterior vaginal wall, and Fig. 4 pictures the herniation of abdominal viscera other than the rectum through the posterior wall of the vagina by way of the same deep pouch. It is almost unnecessary to point out how readily these conditions may be distinguished upon rectal examination and how a true rectocele interferes with the act of defecation.

Figure 5 illustrates a degree of prolapse of the posterior vaginal wall sufficient to draw down the uterus. A further descent of the uterus would result in procidentia.

In respect to the cure of such conditions, it goes without saying that the closure of the deep pouch is part of a combined procedure of which the first step is an extensive repair of the anterior and posterior vaginal walls.

## IRRLAIMENT OF UTERINE PROLAPSE AND RECTOCELE

Whether or not the entire operation vaginal and abdominal, is accomplished at one sitting depends upon the excellence of the patient as an operative risk. Not rarely two sittings are advisable, especially in the aged, for after a long and perhaps bloody vaginal repair the abdominal operation may entail a considerable risk.

In the performance of the closure of the cul-de-sac a rather extreme Trendelenburg position is helpful. Should examination with the pelvis exposed then demonstrate the presence of a very deep pouch of Douglas, that is, a pouch extending down be-

tween rectum and vagina for two, three or even four inches beyond the cervix, a pouch which very likely has already been closed in some degree by the repair of the posterior vaginal wall, the cul-de-sac may be obliterated in any convenient way. I have used spiral stitches of large chromicized catgut, one for each side of the pelvis and not the series of circular silk stitches advocated by Doctor

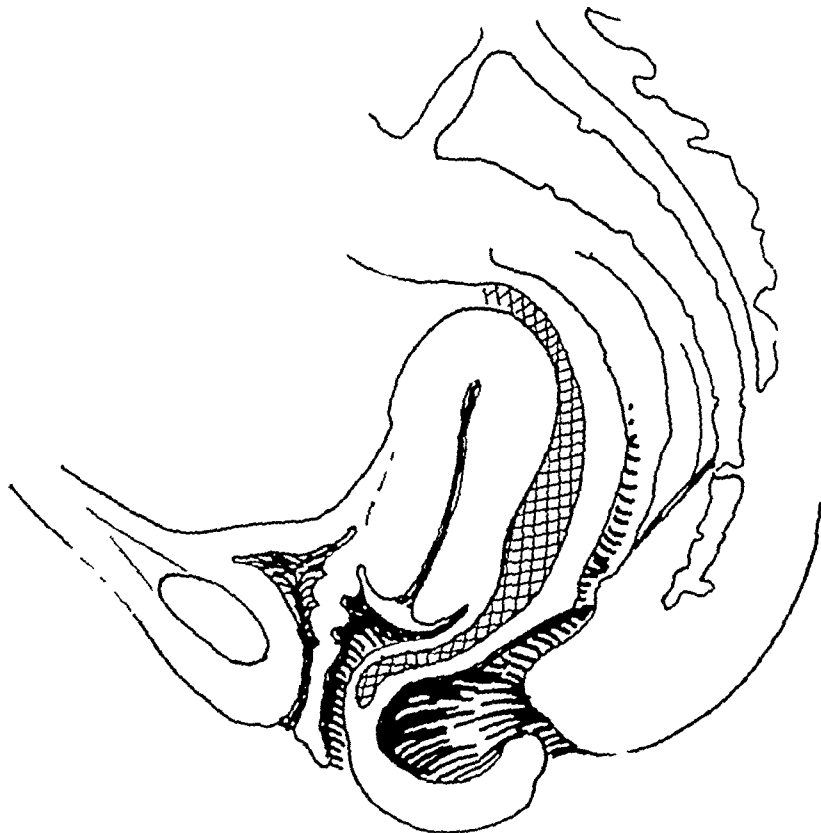


FIG. 3.—Diagram representing a true rectocele. The anterior rectal wall pushes into vagina thrusting the posterior vaginal wall forward and downward. The uterus is retroverted and in a state of moderate prolapse. Rectal examination discloses the nature of this change.

Moschcowitz, for the reason that the two stitches flatten the pouch from back to front and draw the cervix toward the sacrum with less danger, I believe, of having the stitches pull out of the peritoneum and feeble fascia behind it than would be the case with circular stitches, nor do I see the need of a non-absorbable suture material.

Figure 6 illustrates the starting of one of these stitches, the fundus of the uterus being drawn forward and the sigmoid pushed well up into the abdomen. Each stitch starts at the bottom of the pouch and is carried up in a spiral manner picking up the vaginal wall, lateral pelvic wall and lateral surface of the rectum in a series of turns up to a level perhaps an inch above the lowest point of the cervix. Figure 7 shows both stitches in place but not yet drawn tight. When both are completed the cervix is drawn firmly toward the promontory of the sacrum and the pouch of Douglas is obliterated except

for a narrow slit between rectum and cervix. This may be closed at the top by additional stitches if it seems to offer a point of entry for the small intestine.

As to the disposal of the uterine fundus, any one of several methods may reasonably be employed—a Gilliam suspension, an Ohlshausen fixation of the round ligaments or a firmer fixation of the fundus itself with catgut or silk, the desideratum being to pitch the fundus forward so that the uterus shall lie as a shelf across the brim of the pelvis.

It will be noted by examining Fig. 8 that in the standing position, intra-abdominal pressure is little exerted against the cervix but is, for the most

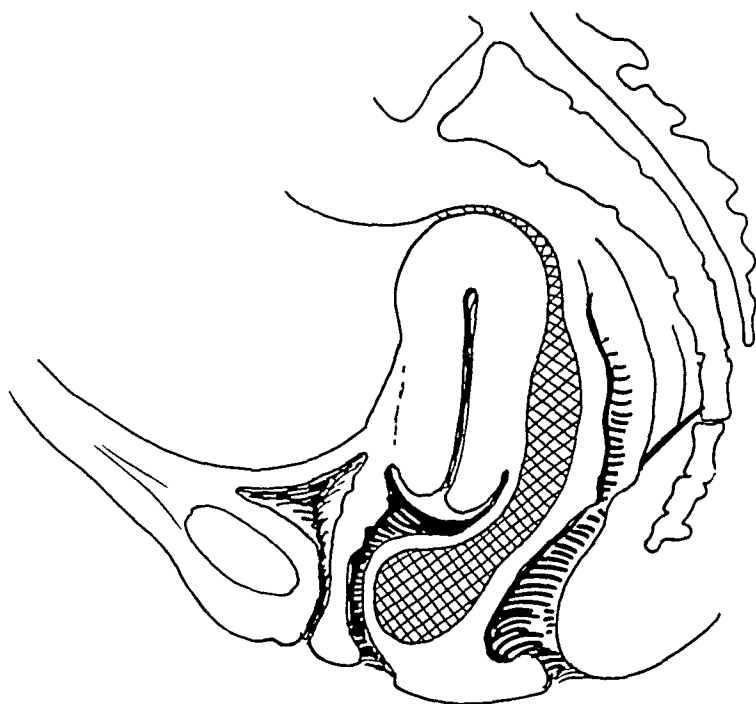


FIG. 4.—Diagram representing a protrusion of the posterior vaginal wall that is a herniation of the pelvic contents through the posterior vaginal wall by way of a deep pouch of Douglas. Rectal examination will show that this is not a true rectocele.

part, transmitted by the body and fundus of the uterus toward the anterior abdominal wall. Thus the operation not only closes the neck of the hernial sac leaving the uterus almost like a shelf across the superior strait of the pelvis † but tends to prevent the swinging back of the cervix into the axis of the vagina. The operation is not an easy one and requires patience and care.

#### *The Selection of Patients for Operation*

No particular plan has been used in choosing subjects for this operation. In carrying out the abdominal part of a combined operation for prolapse or procidentia, Douglas' fossa was closed whenever it appeared to be particularly deep, or roughly, when it extended for more than two inches below the cervix. On this basis, as I now discover, more of the patients operated upon suffered from a pronounced relaxation of the anterior vaginal wall than of the posterior. In these individuals the deep cul-de-sac can hardly be held to have been the starting point of the associated descent of the uterus. I believe, however, that the inclusion of these cases in the series, though a departure

† The interposition of the uterus at the upper end of the pelvic outlet, though not a primary object of the operation, has an advantage over the "Interposition" operation of Watkins in which the uterus is brought forward in front of the bladder, for that operation still leaves the way open for the development of rectocele, that is, by a push from behind and below the cervix, while with closure of the pouch, a recurrence of rectocele is unlikely.

from the indications laid down by Doctor Jones adds to the value of this report. All patients in the series suffered from such a degree of prolapse that the cervix appeared at or outside the vulva on standing.

*Results*—The operation has been performed upon thirty-two patients, varying in age from twenty-one to seventy-one. The earliest operation was performed in 1916, the most recent in 1923. In all instances, more than two years have elapsed between the operation and the date of the final report. There were no operative deaths in the series.

Of the thirty-two patients treated thirty have been traced. In a large majority of these instances the patients have actually been examined. In a few, the patient's own statement has been accepted as a basis for the result reported. Patients are considered to have been cured in whom the anatomic result is satisfactory or who without examination report themselves as being in good health and without complaints. Patients are considered to have been improved who present an ana-

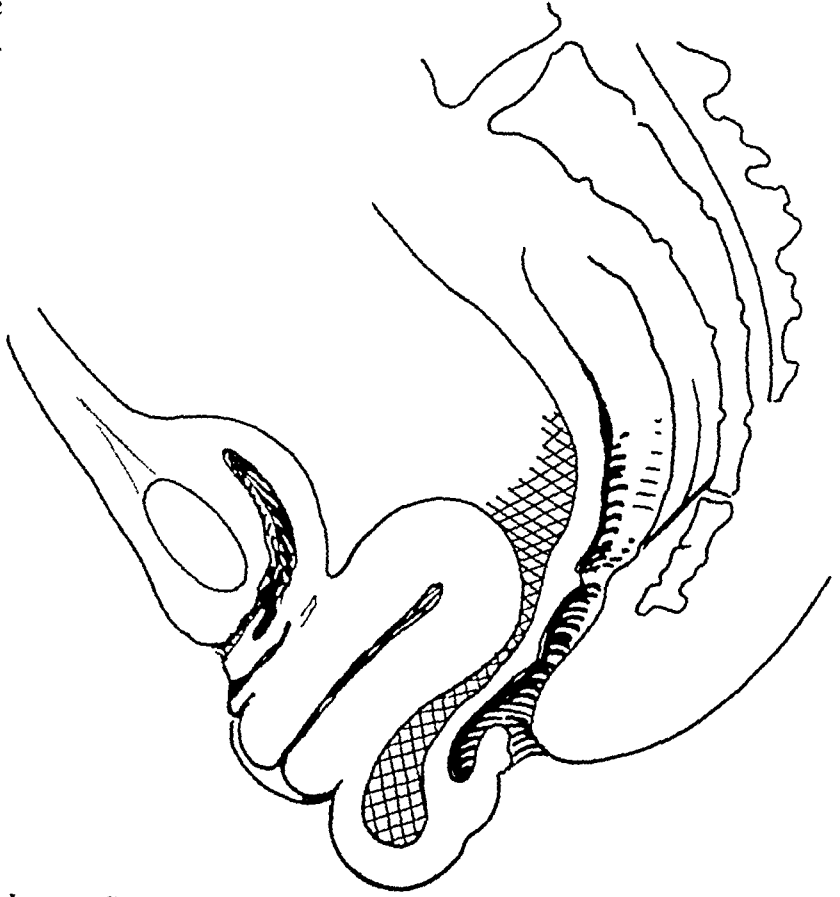


FIG. 5.—Diagram representing a considerable descent of the uterus in association with a deep pouch of Douglas.

tomie recurrence with a functional cure or who have been partly relieved both anatomically and functionally. These definitions govern the report of results detailed below.

Of the thirty cases traced twenty-two were cured, or 73.3 per cent, four were improved, making a total of twenty-six cured and improved cases, or 86.7 per cent. There were four total failures, or 13.3 per cent.

The failures are somewhat instructive and give more than a hint of the circumstances under which the operation is likely to fail. The first resulted from my poor judgment in performing the operation in the presence of a

† It is clear that as regards the anatomic result a physical examination is alone satisfactory. As an instance of an anatomic failure which would have been missed without a physical examination, one woman reported herself as having been entirely relieved, yet the cervix descended to the vulva on standing.

chronic tube-ovarian abscess, the second patient had previously been operated upon at other hands with immediate recurrence, the third, a very neurotic woman who had previously been subjected to some other pelvic operation, reported herself a failure and was again operated upon by another surgeon (hysterectomy) without relief, and the fourth was mistakenly allowed to go without a repair of the posterior vaginal wall. In none of the four was rectocele a predominating factor. Two were instances of symmetrical procidentia and two of prolapse with a predominating cystocele.

Of the four improved cases, two were young women who have since borne

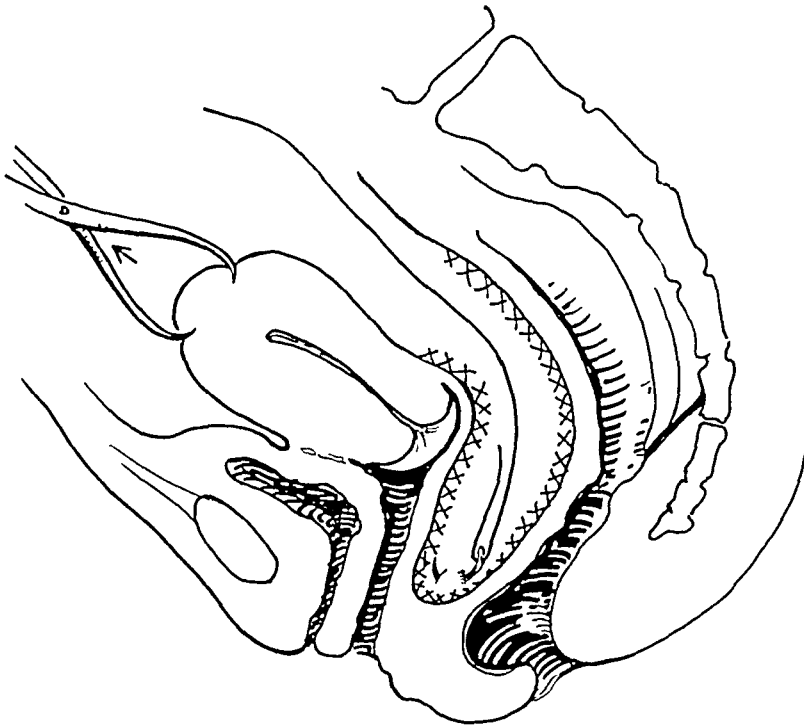


FIG. 6.—Diagram to show the starting of one of the lateral spiral stitches. The lines of crosses indicate the extent of the proposed closure of the pouch of Douglas.

children. In both, the operation had been completed by a Gilliam suspension. Both have been considerably relieved and are reasonably satisfied with their condition, and one of them, who suffered from procidentia before operation, has no sign of uterine protrusion at present. A third patient "felt something give way" over a

year after operation and now the cervix comes to the vulva on straining, yet she considers herself well.

The cured patients, 73.3 per cent of the list, comprise seven instances of procidentia among which were three patients suffering from an excessive relaxation of the anterior vaginal wall, one from a predominance of rectocele and three from a symmetrical protrusion of the uterus. Of the fifteen cases of prolapse, six showed a dominant cystocele, four a symmetrical protrusion and five a dominant relaxation of the posterior vaginal wall. The patients were of all physical types, several being aged, flabby women whose abdominal walls were greatly relaxed. I am inclined to believe that the operation has had among these patients a fair test which demonstrates its usefulness in a variety of pathologic conditions of which the basic lesion is herniation of the uterus through the pelvic outlet. In fact the operation in many instances has

## TREATMENT OF UTERINE PROLAPSE AND RECTOCELE

closed the neck of the hernial sac and, supported by a thorough vaginal repair, has aided materially in the cure

Without quoting individual cases, I feel justified in suggesting some of the conditions for which the operation appears, by a study of the results, to be excellently suited and others to which it is less well suited

First and foremost it is suitable to instances of prolapse or procidentia in which rectocele is a predominating factor. In this short series there are, among such patients, no failures. Two patients, indeed, whose cul-de-sacs were astonishingly deep, suffered at one time from rectal prolapse and at another from rectocele. Each was cured of both conditions. Second in significance is the success of the operation among women who have a large uterus. The factor of size seems to favor the interposition of the uterus as a bar or shelf across the pelvis, shutting the intestines against the pubis and the lower abdominal wall. The helpfulness of a good-sized uterus favors the use of the operation in young women who may

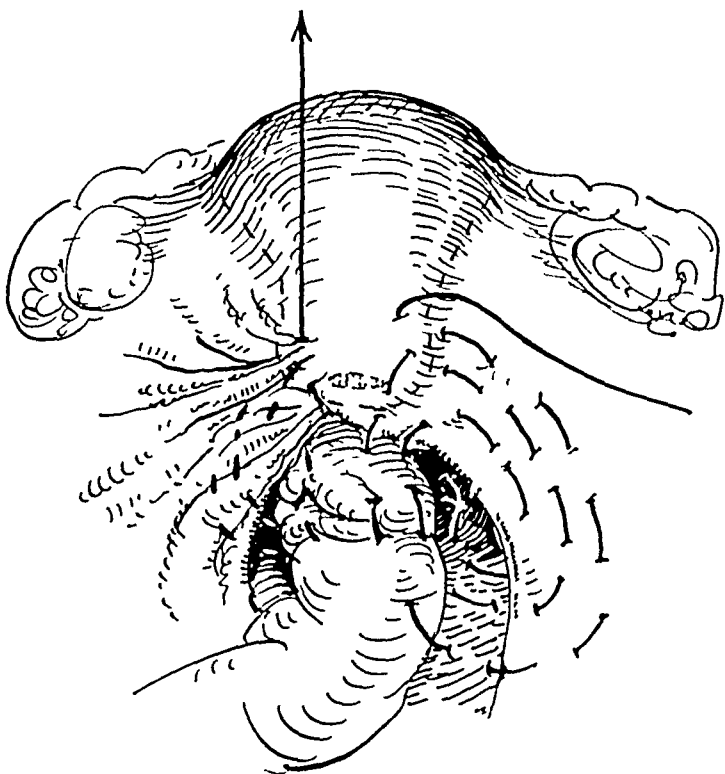


FIG. 7.—Sketch of the pelvis from above to show the placing of the two spiral stitches and the nature of the closure they produce

indeed be left unsterilized and subsequently bear children without total recurrence. Conversely, an atrophied uterus would appear to be an unfavorable factor, yet one patient in the series was subjected to closure of the pouch for a vaginal prolapse which had followed a total hysterectomy and the result has been good.

The third significant factor in the operation is the very small part which the character of the abdominal wall plays in its success. The attachment of the fundus or of the round ligaments to the rectum is used rather to tilt the fundus forward than to fix it permanently. In fact the operation has succeeded admirably in a number of women with badly relaxed and protruding abdominal walls.

The operation is difficult to perform without the aid of a rather exaggerated Trendelenburg position and very thorough walling off of the intestine. For this reason it offers a severe ordeal for women with feeble hearts and excessive adiposity. Moreover the presence of an excessive amount of fat about the sigmoid flexure and behind the peritoneum makes closure of the deep



pouch a difficult feat. A feeble heart and excessive fatness are therefore contra-indications.

To sum up, closure of the pouch may be a difficult but not of itself a dangerous procedure. It not only closes with some effectiveness the neck of the hernial sac but leaves the uterus interposed across the superior strait of

the pelvis, the fundus anterior and the cervix posterior, in such a position that pressure from above is transmitted forward toward the pubis and no longer tends to push the cervix down into the axis of the vagina.

And though the procedure, as here reported, has been used without the aid of very carefully determined indications, it may apparently be relied upon, in association with a thorough

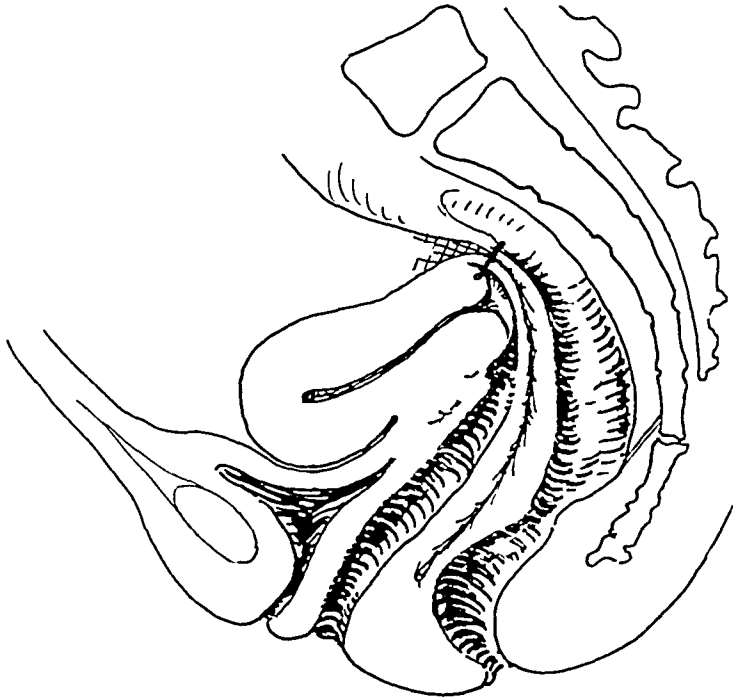


FIG. 8.—Diagram to show the closed pouch and the position of the uterus at the conclusion of the operation.

vaginal repair, to cure a rather high percentage of prolapse and procidentia, and is useful especially when the posterior rather than the anterior vaginal wall is chiefly relaxed, when the uterus is of fair or good size and when the abdominal wall is so relaxed as to offer a poor support for any form of fixation.

#### BIBLIOGRAPHY

- <sup>1</sup> Moschcowitz, A. V. *Surg, Gyn and Obst*, 1912, vol. 11, p. 7.
- <sup>2</sup> Jones, D. F. *Boston Med and Surg Jour*, 1916, vol. 111, p. 623.
- <sup>3</sup> Clark, J. G. *Surg Clinics of North America*, 1921, vol. 1, p. 77.
- <sup>4</sup> Frank, L. *Am Jour of Obst*, 1917, vol. 111, p. 706.
- <sup>5</sup> Graves, W. P. *Text Book of Gynecology*, 1918, p. 699.

# A HANGER METHOD FOR THE REPAIR OF PROCIDENTIA UTERI\*

By GEORGE W. CRILEY, M.D.

OF CLEVELAND, OHIO

It is easy to operate for procidentia. It is difficult to cure procidentia. To operate is easy because the tissues are elastic and abundant. To cure is difficult because the tissues are elastic and abundant. Because of their elasticity neither the perineum nor the utero-sacral, the anterior nor the broad ligaments can provide a permanent anchorage. Every surgeon is familiar with the patients who, after a suspension operation for the cure of procidentia, return with the same symptoms—the same distress and a second partial or not complete prolapsus of the uterus.

The necessity of providing some permanent anchorage was impressed upon me twenty-one years ago by a patient with complete procidentia for which she had already been operated upon elsewhere twice with but temporary relief, the first operation having been performed fifteen years before, the second operation but six months before. The patient was a Bohemian woman whose livelihood demanded the performance of heavy manual labor. In despair of providing any permanent relief by the operative method which had already been twice tried without avail I decided to utilize the one available permanent anchorage—namely the anterior abdominal wall and by practically the same technic as that which I shall describe, I suspended the entire floor of the pelvis—the bladder, the rectum and a portion of the uterus—on the abdominal wall. The result justified the adventure and the woman returned to her heavy manual labor without further misadventure.

At about the same time another case with a somewhat similar history gave another opportunity to try the same manœuvre again with success. Since that time this manœuvre has been employed in a number of cases of procidentia. As it necessitates a partial hysterectomy, it is obviously not adapted to prolapsus within the child-bearing period.

The technic may be briefly described as follows. A low abdominal incision is made to the right of the median line. A wedge-shaped section of the central part of the uterus, the apex extending down to the cervix, is removed, leaving a lateral strip of uterus free of mucosa on each side, together with the attachments of the round, the broad, the anterior and the utero-sacral ligaments. Bleeding is controlled and the raw surface of each side and across the cervix is covered by suturing. The entire group of organs—the bladder, the rectum, the cervix and the vagina—involved in the descensus may be raised or lowered by these two handles and it remains only to find the anchorage whereby the group may remain permanently elevated by these handles.

To this end a short incision is made through the external fasciæ, muscle and peritoneum, parallel to the original incision but just to the left of the

---

\* Read before the American Surgical Association, May 4, 1925.

median line as in a Gilliam operation this opening, however, being made just large enough to draw through it the left "handle" of the descensus complex, the right handle is brought up through the primary incision. Thus the two "strap handles" emerge well up and out of the right and left

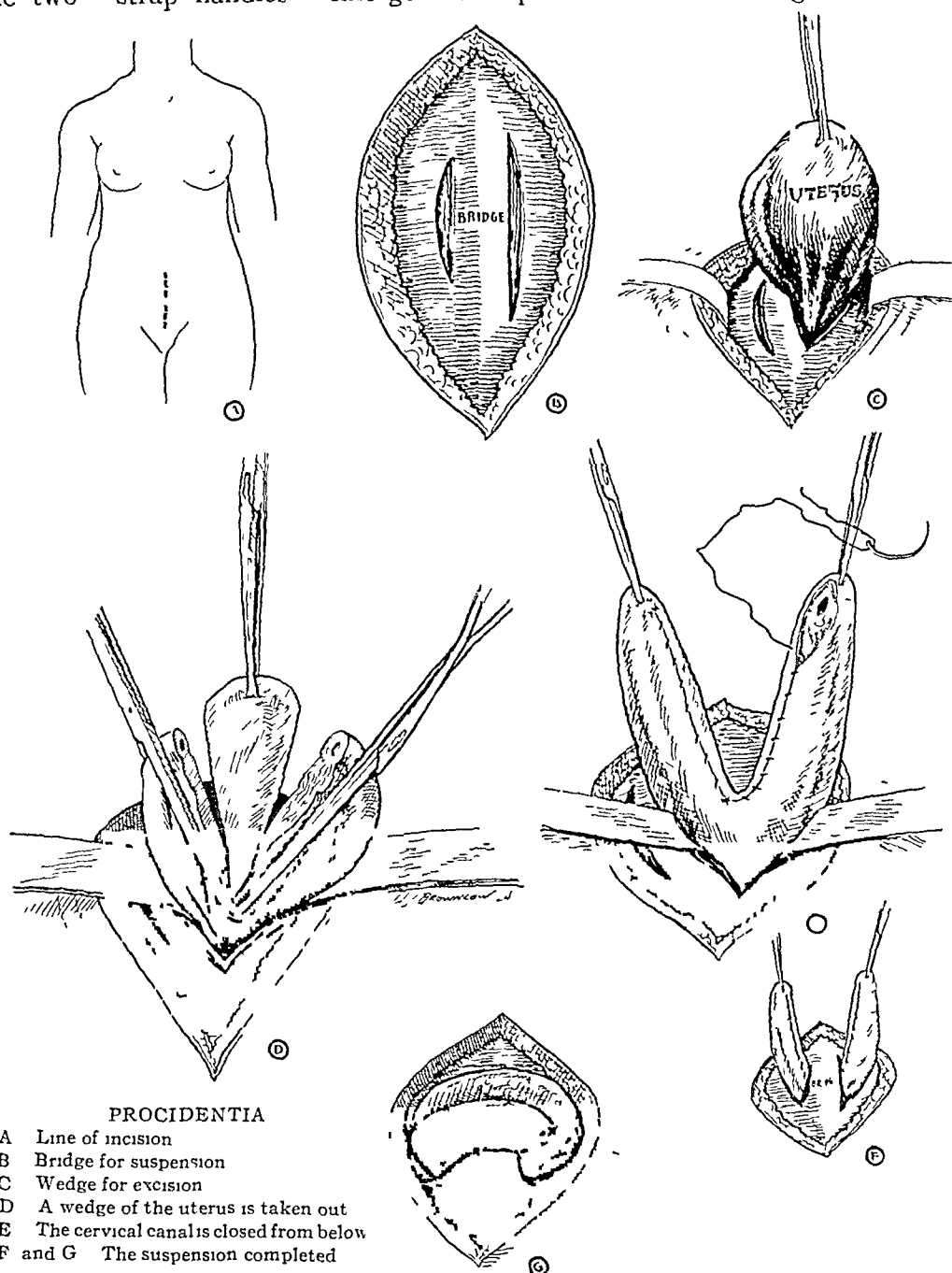


FIG 1 —A hanger method for the repair of procidentia

incisions with a substantial and dependable strip of abdominal wall lying between them. The two handles are crossed over this strip as if to grasp it and are sutured there, thus forming a permanent immovable opponent to further descensus.

## REPAIR OF PROCIDENTIA UTERI

It is obvious that the condition which makes this operation possible is the one sure indication for its performance. Unstretched ligaments can not reach the abdominal wall but unstretched ligaments in turn are still capable of performing their essential suspending functions. It is the stretched tissues in which the elasticity has been exhausted by constant strain that on the one hand indicate the need for the operation, and on the other, permit the manœuvre to be accomplished.

As to the relief of the condition it is obvious that there can be no recurrence of procidentia as such. In extreme cases, however, there has been a partial cystocele and rectocele. For a short time after the operation the patient will inevitably feel a tugging upon the abdominal wall. This discomfort, however, is of limited duration and it deserves but slight consideration in contrast to the diminished probability of a return of the prolapsus. It should be borne in mind also in estimating the value of the procedure that procidentia is most prone to occur after the child-bearing period in multiparous women in whom the entire generative apparatus is already stretched and weakened beyond the possibility of permanent restoration by other manœuvres.

## CORRESPONDENCE

### LATE RESULT OF NEEDLING AN AORTIC ANEURISM

EDITOR ANNALS OF SURGERY

Sir

In the ANNALS OF SURGERY for November, 1912, under the title of "The Surgical Treatment of Aortic Aneurism," I reported a case in which, in spite of prolonged medical treatment, the symptoms became so severe that the patient and her doctor thought she was dying.

After a series of needlings by the method devised by Sir Wm Macewen, patient improved so markedly that, as she expressed it, she was given a new lease of life. She was able to go to the Coast for a holiday in 1910, after three needlings, and after further treatment at the end of 1910, she was able to resume her ordinary household duties.

Recently, owing to her having strained herself by repeated lifting of a very heavy preserving pan, while making marmalade, there was a modified recurrence of symptoms, and she came to see me at the Royal Infirmary, Glasgow.

A needle introduced on this occasion encountered a much thickened *anterior* wall of the aneurism, thus showing that the effect of the needling is not confined to the area on the posterior wall, scratched by the needle, but extends gradually round the circumference.

The case was shown by me to the Members of the Inter-State Post-Graduate Clinic Tour of American Physicians who visited my Clinic at the Royal in June of this year.

Thus this woman who was very seriously ill and appeared to be dying in 1909, has been able, after treatment by needling, to carry out her ordinary work and enjoy life for a subsequent period of 15 years, which I think, justifies my again drawing the attention of the Profession to a very valuable method of treating all aneurisms, but particularly those where other methods are not available, as in the aortic variety.

JOHN A. C. MACEWEN, M.D.,  
Glasgow

#### To Contributors and Subscribers

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

**ANNALS OF SURGERY**

**227-231 So. 6th Street**

**Philadelphia, Penna.**

# ANNALS *of* SURGERY

VOL. LXXXII

OCTOBER, 1925

No. 4

## CONTRIBUTIONS TO BRAIN SURGERY

### A. REMOVAL OF CERTAIN DEEP-SEATED BRAIN TUMORS B. INTRACRANIAL APPROACH WITH CONCEALED INCISIONS

By WALTER E. DANDY, M.D.

of BALTIMORE, Md.

FROM THE DEPARTMENT OF SURGERY OF THE JOHNS HOPKINS HOSPITAL, BALTIMORE, Md.

**A Removal of Certain Deep-seated Brain Tumors.**—The successful removal of encapsulated tumors on the surface of the brain offers no insuperable difficulties. An accurate and adequate exposure of the tumor, absolute control of hemorrhage at operation with the assurance of no post-operative bleeding, and the avoidance of injury to the brain tissue during the removal of the tumor, are the three great factors upon which a favorable outcome from extirpation of these tumors depends. The accurate localization of all brain tumors now being possible, the exposure of superficially situated tumors should be correspondingly accurate and should be sufficient for the need. With the re-

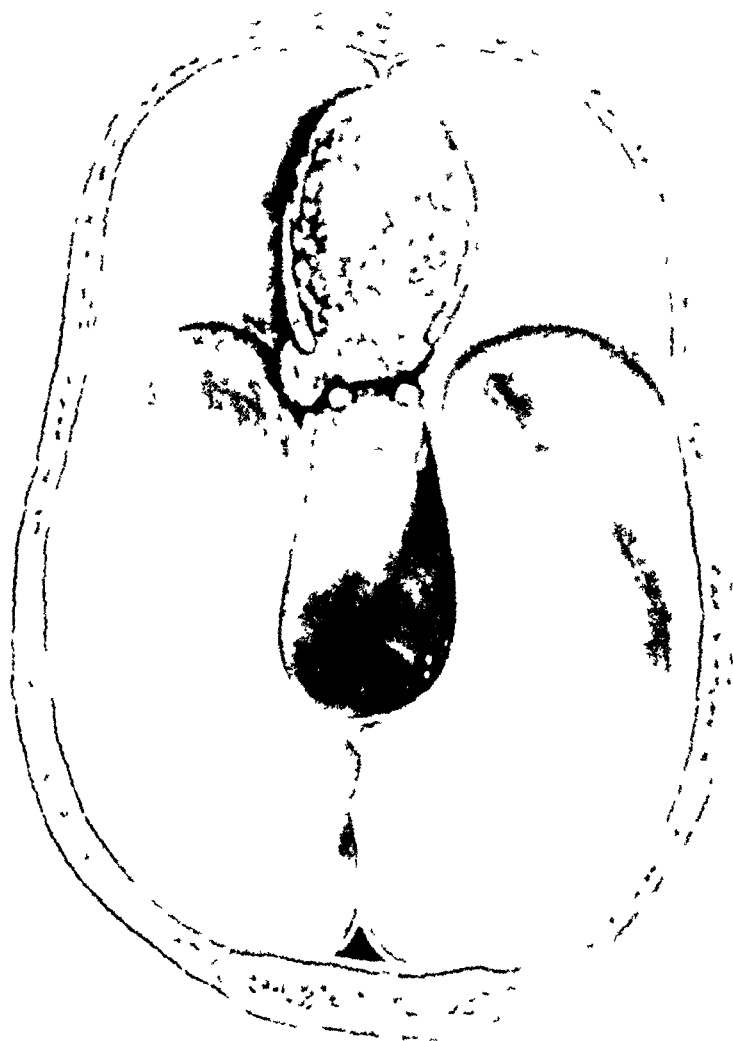


FIG. 1.—Drawing to show the location and position of the tumor for the removal of which the procedure here described is used. The tumor is a dural endothelioma arising from the cribriform plate and pushing aside both olfactory nerves.

removal of all such tumors we are not concerned at the present time. But many intracranial tumors—potentially benign—are not so fortunate.

nately situated. They may be within the brain substance (principally ependymal tumors) but a greater number arise from the meninges (dural endotheliomata) and are partially or entirely hidden from the view offered by any operative approach. To attempt the extirpation of such deeply situated dural tumors by the usual method of shelling them out with the finger, is always a matter of great concern and is attended by a prohibitive mortality rate. Although the causes of this high death rate are readily understood—cerebral trauma and hemorrhage—they are not so easily avoided. The first prerequisite of any operative procedure—a good exposure—cannot be

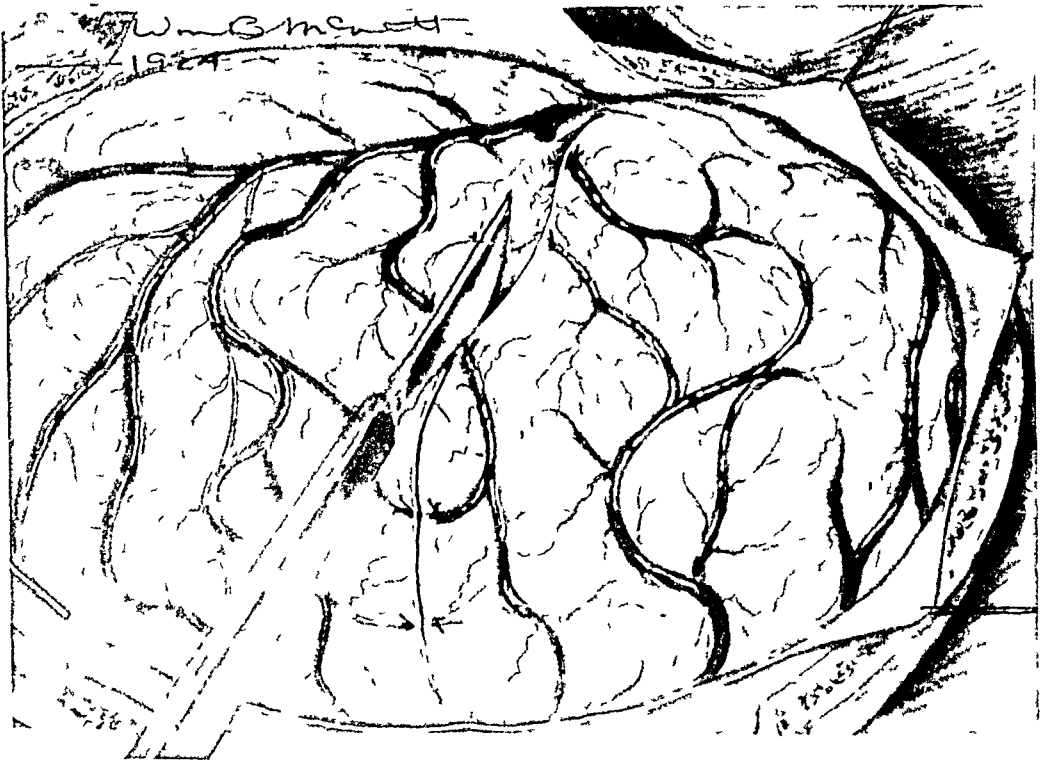


FIG. 2.—First step in the resection of the left frontal lobe. This resection was necessary to obtain an exposure adequate to permit removal of this tumor. The vessels on the surface of the brain are ligated by two sets of silk ligatures between which the incision is carried to the cortex.

obtained because of the deep and concealed position of the growth. Enucleation is therefore largely performed in the dark. In order to reach the tumor it is inevitable either that the brain be penetrated or strongly retracted, and even then the exposure is transitory and imperfect. Under such conditions bleeding can be controlled only by quickly packing a hidden cavity. An operation so performed is not a procedure of merit but rather a desperate effort. An occasional successful outcome is scarcely justification for the great hazards, even with the otherwise hopeless outlook for individuals so afflicted.

The purpose of this communication is to present a method by which many of these tumors can be exposed. At first glance it may appear radical, but the radical feature has been used in other operations<sup>1</sup> and is now used without

<sup>1</sup> Dandy, W. E. Treatment of Non-encapsulated Brain Tumors by Extensive Resection of Contiguous Brain Tissue. Johns Hopkins Hospital Bulletin 1922 vol XXXIII, p. 188.

apparent harmful effect to the patient. I refer to resection of so-called silent parts even, if need be, lobes of the brain. Such resections were first tried in the effort to totally eradicate gliomata which otherwise invariably recurred after their partial removal. The seemingly harmless effect of resecting a silent lobe of the brain is less surprising when we appreciate the fact that at the time the operation is performed, much of the brain tissue which is included in the resected mass has been destroyed by the tumor, and no signs or symptoms of localization have resulted from the destruction of the lobe



FIG. 3.—The tumor is dissected through the cortical lobe. The tumor is removed by a surgical clip.

by the tumor. Moreover, such disturbances as irritability, forgetfulness, dizziness, etc., due to the tumor's presence (pressure) but of no localizing importance, disappear when the tumor is removed with the contiguous brain tissue.

Frequently during the past few years we have carefully excised varying amounts of cortex and the subjacent white matter (in silent areas) overlying a tumor in order to better inspect the tumor and determine whether or not its character will permit enucleation and also to help in the more careful dissection of the neoplasm. Cortical resections are on the whole superior to transsections. When tumors are scooped out through an incised cortex, the contiguous brain tissue is always badly traumatized both from the extirpation and even more from efforts at hemostasis. The injury so induced leads to numerous small hemorrhages and a cerebral edema of such magnitude that not infrequently before closing the wound not only has the cavity from which the tumor has just been removed, become entirely obliterated, but the intra-



cranial pressure may even be greater than when the dura was first opened. This effect of cerebral injury is one of the greatest factors in the operative mortality following the extirpation of brain tumors.

The case which is here reported offers a severe test of the usefulness of this operative procedure since it was necessary to remove, as a preliminary measure, the *left* frontal lobe in a right-handed individual. Though this lobe has long been thought to be most concerned with the intellectual function of



FIG. 4.—Showing the frontal lobe nearly resected, the tumor just appearing behind a vessel which is ligated with silver clips. The anterior horn of the lateral ventricle has been opened near the tip.

the brain, lobe resections have shown that it may be removed without any appreciable mental impairment.

The diagnosis and localization of this tumor offered no particular difficulties. He was a well-developed man of forty-three. For eighteen months he had complained of severe headaches which begin in the frontal region and radiate around both sides to settle in the occiput. At first the headaches occurred every two or three months and lasted from two to five days. Gradually they have become more frequent, now at intervals of two to three weeks. Dizziness frequently and double vision occasionally accompany the headaches. Dizziness is associated with a tendency to fall forward. Peculiar foul odors and tastes for which there is no obvious explanation (uncinate attacks) are associated with these spells, and food taken at these times is either bitter or tasteless. At times there are attacks in which the head draws forward, the neck becomes rigid, blind spots appear, and occasionally there is also a dazzling array of colors. In none of the attacks was there loss of consciousness or generalized convulsions (grand mal). The headaches were always intensified during these spells. He thinks his

# REMOVAL OF DEEP INTRACRANIAL TUMORS

memory is definitely affected during the attacks but a quick recovery follows. There has been no vomiting.

The only positive findings on examination were double symmetrical choked disc of moderate grade, complete anosmia, a beginning restriction of the right homonymous visual fields. The reflexes were unchANGED, no Babinski, no ankle clonus. The X-ray showed neither a shadow nor an area of destruction. From the findings we considered the tumor's probable location to be under the left frontal lobe.

The disclosure of the tumor was not easy despite a very large bone-flap which extended far forward over the frontal lobe. Inspection of the entire outer surface of



FIG. 5.—Tumor exposed after resection of the frontal lobe. The anterior table of the frontal bone, the lesser wing of the sphenoid and therefore the entire normal apex of the middle cranial fossa were removed. At this exposure it was possible to remove the tumor completely.

the left hemisphere and of the inferior surface of the left temporal and frontal lobes revealed no sign of a tumor. The lower part of the frontal lobe however seemed a little softer than the neighboring parietal lobe. A ventricular needle was inserted into the area of softening (just anterior to Broca's convolution) and encountered a resistance about 6 cm. below the surface. A nasal dilator was used to follow up the track of the ventricular needle, and when the blades were spread apart the small part of the tumor which was visible was seen to be characteristic of a dural endothelioma, therefore a potentially benign tumor. The inferior surface of the frontal lobe was again inspected and the tumor exposed only when the left olfactory nerve was brought into view. The brain was slightly adherent to the floor of the skull just mesial to this nerve and when these adhesions were gently broken the tumor could be seen. It was situated almost precisely in the centre of the floor of the anterior fossa of the skull and posteriorly projected over the lesser wings of the sphenoid into both the right and left middle cranial fossae. Firmly attached to the dura of the cribriform plate—from which it arose—this encapsulated tumor extended as far to the right as to the left.

cranial pressure may even be greater than when the dura was first opened. This effect of cerebral injury is one of the greatest factors in the operative mortality following the extirpation of brain tumors.

The case which is here reported offers a severe test of the usefulness of this operative procedure since it was necessary to remove, as a preliminary measure, the *left* frontal lobe in a right-handed individual. Though this lobe has long been thought to be most concerned with the intellectual function of

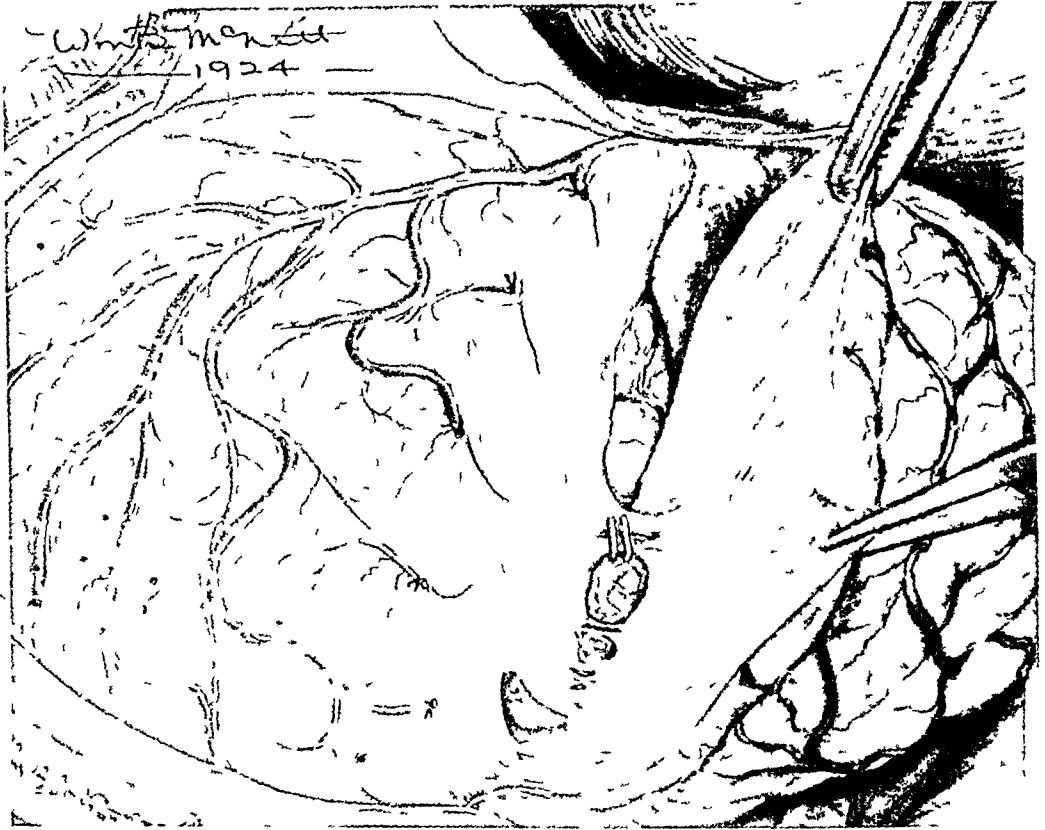


FIG. 4.—Showing the frontal lobe nearly resected, the tumor just appearing behind a vessel which is ligated with silver clips. The anterior horn of the lateral ventricle has been opened near the tip.

the brain, lobe resections have shown that it may be removed without any appreciable mental impairment.

The diagnosis and localization of this tumor offered no particular difficulties. He was a well-developed man of forty-three. For eighteen months he had complained of severe headaches which began in the frontal region and radiate around both sides to settle in the occiput. At first the headaches occurred every two or three months and lasted from two to five days. Gradually they have become more frequent, now at intervals of two to three weeks. Dizziness frequently and double vision occasionally accompany the headaches. Dizziness is associated with a tendency to fall forward. Peculiar foul odors and tastes for which there is no obvious explanation (uncinate attacks) are associated with these spells, and food taken at these times is either bitter or tasteless. At times there are attacks in which the head draws forward, the neck becomes rigid, blind spots appear, and occasionally there is also a dazzling array of colors. In none of the attacks was there loss of consciousness or generalized convulsions (grand mal). The headaches were always intensified during these spells. He thinks his

## REMOVAL OF DEEP INTRACRANIAL TUMORS

memory is definitely affected during the attacks, but a quick recovery follows. There has been no vomiting.

The only positive findings on examination were double symmetrical choked disc of moderate grade, complete anosmia, a beginning restriction of the right homonymous visual fields. The reflexes were unchanged, no Babinski, no ankle clonus. The X-ray showed neither a shadow nor an area of destruction. From the findings we considered the tumor's probable location to be under the left frontal lobe.

The disclosure of the tumor was not easy despite a very large bone-flap, which extended far forward over the frontal lobe. Inspection of the entire outer surface of



FIG 5—Tumor exposed after resection of the frontal lobe. The resection of the lobe has exposed the lesser wing of the sphenoid and therefore the anteriormost part of the middle cranial fossa. With this exposure it was possible to remove the tumor completely.

the left hemisphere and of the inferior surface of the left temporal and frontal lobes revealed no sign of a tumor. The lower part of the frontal lobe, however, seemed a little softer than the neighboring parietal lobe. A ventricular needle was inserted into the area of softening (just anterior to Broca's convolution) and encountered a resistance about 6 cm below the surface. A nasal dilator was used to follow up the track of the ventricular needle, and when the blades were spread apart the small part of the tumor which was visible was seen to be characteristic of a dural endothelioma—therefore a potentially benign tumor. The inferior surface of the frontal lobe was again inspected and the tumor exposed only when the left olfactory nerve was brought into view. The brain was slightly adherent to the floor of the skull just mesial to this nerve and when these adhesions were gently broken, the tumor could be seen. It was situated almost precisely in the centre of the floor of the anterior fossa of the skull and posteriorly projected over the lesser wings of the sphenoid into both the right and left middle cranial fossæ. Firmly attached to the dura of the cribriform plate—from which it arose—this encapsulated tumor extended as far to the right as to the left.

and was skirted on both sides by the olfactory nerves which were curved around its sides (Fig 1) Situated in this inaccessible position—entirely beneath the brain and under both hemispheres—the operative approach would permit the exposure of only a small fraction of the tumor's surface and this only by applying undue retraction of the brain, which was already bulging from pressure

Two courses were open (1) to leave the tumor in place and be content with a palliative decompression, or (2) to make a better exposure of the tumor by resecting the left frontal lobe and then attempting the tumor's removal With palliation life might be preserved for some time, but the uncertain and genuine epileptic attacks would not be benefited and sooner or later vision would be lost from direct pressure of the tumor

upon both the optic nerves and the optic chiasm and of course eventually death was inevitable—together at best a most depressing outlook Any attempt to blindly extirpate such a bloody tumor with the finger would have meant certain death from hemorrhage and cerebral trauma

From past experiences we were justified in assuming that a resection of the left frontal lobe was comparatively safe and harmless There seemed no other hope of a successful extirpation Since the tumor was of the benign encapsulated and non-recurring

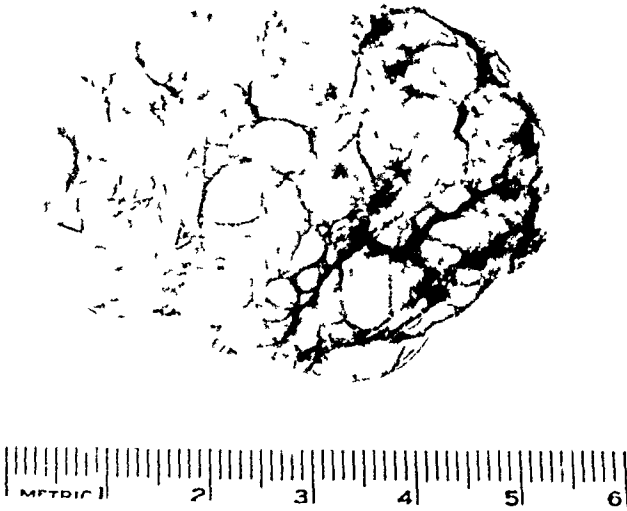


FIG 6—Photograph of the tumor, its weight is 36 grams

type its successful removal would surely result in a permanent cure, preservation of eyesight, and probably also in the cessation of the epileptic attacks (with the uncinete auræ)

Against removal of the tumor with preliminary resection of the frontal lobe there was not only the added risk to life but also the danger of injuring the motor speech centre The additional danger to life could probably be obviated by the safer plan of removing the tumor at a second-stage operation two or three weeks later should this appear necessary The advisability of a one- or two-stage procedure could be left for a decision (depending upon the patient's condition) after the frontal lobe had been resected And from the results of previous left frontal resections there seemed no doubt that injury to the speech centre (Broca's area) could be avoided

After carefully ligating the veins entering the longitudinal sinus, the cortical vessels, and the subcortical vessels as they were encountered, the left frontal lobe was excised (Figs 2, 3, 4 and 5) A safe margin of tissue was left anterior to Broca's area The resulting cerebral defect extended mesially to the falx and posteriorly to the optic foramen (Fig 5) Except for the dural attachment, almost the entire surface of the tumor could then be brought into view By retracting the *right* frontal lobe even the right side of the tumor could be seen The pole of the tumor which projected over the lesser wing of the sphenoid and dipped into the middle fossa compressed the optic nerves—the left as far back as the chiasm—and the internal carotid arteries though it was not fixed to any of these structures

## REMOVAL OF DEEP INTRACRANIAL TUMORS

Between the tumor and the adjacent brain tissue a layer of wet cotton was packed to serve as a buffer to prevent bleeding along the base of the brain. The tumor was then lifted from its bed without great difficulty. As is always true in dural tumors, the blood supply was largely derived from the dura. A brisk hemorrhage was temporarily checked by packs of wet cotton tightly applied to the denuded dural surface. When the smaller bleeders had been suppressed the larger ones were gradually isolated and the cotton packs replaced by strips of muscle (Horsley's method). Aside from a severe initial reaction from the operation, his recovery was uneventful. There was neither aphasia nor any contralateral motor weakness at any time after the operation. Writing was unaffected. One year after operation patient writes that he is well in every respect.

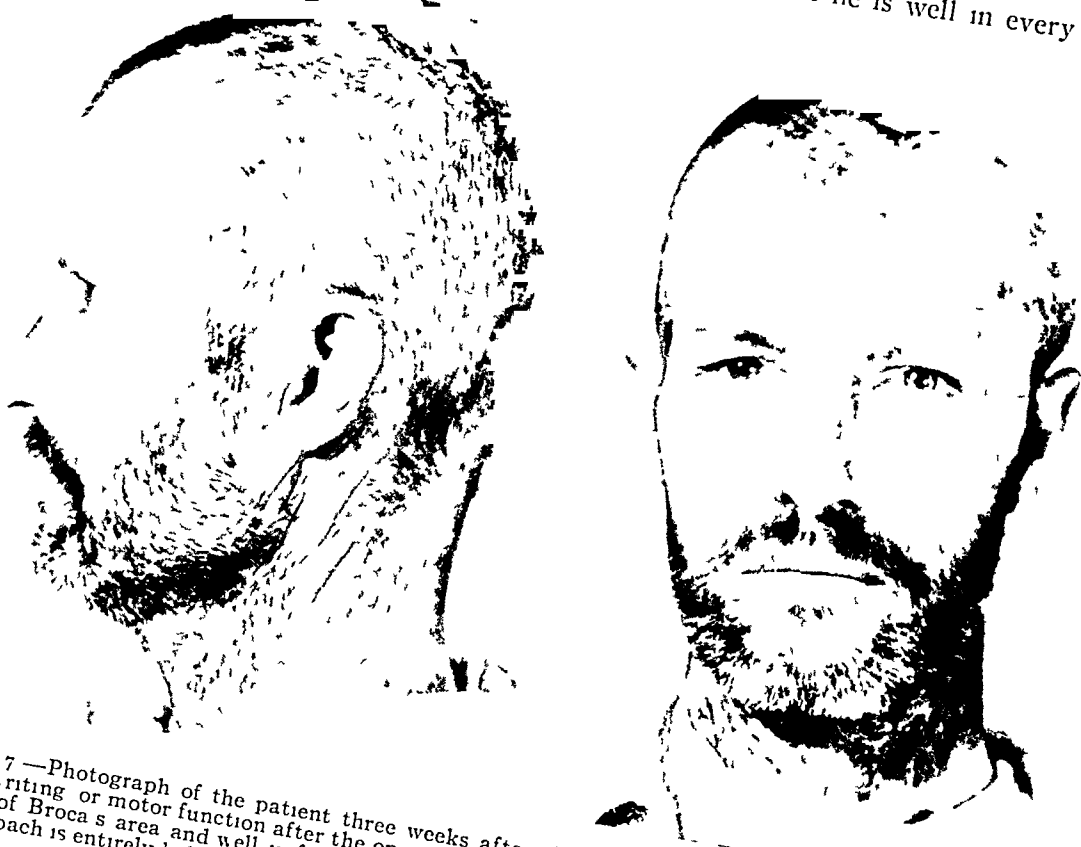


FIG 7—Photograph of the patient three weeks after the operation. There was no disturbance of speech, writing or motor function after the operation for the incision through the cortex was made just in front of Broca's area and well in front of the motor tracts. It will be noted that the scar following this approach is entirely behind the hair line.

The plane of section of the lobe was through the tip of the anterior horn of the left lateral ventricle which was packed with moist cotton to preclude intraventricular hemorrhage. Somewhat more extensive resections of the right frontal lobe often permit inspection of the foramen of Monro and through it the third ventricle. On one occasion a glioma was seen passing from the third ventricle through the foramen of Monro into the lateral ventricle, but the character of the tumor precluded its removal. The only primary enucleable tumor of the third ventricle which I have been able to locate was removed through a modified approach devised for pineal tumors. In that case the corpus callosum was split far enough to allow the foramen of Monro to be brought into view by way of the lateral ventricle.<sup>2</sup>

<sup>2</sup>Dandy W E. Diagnosis, Localization and Removal of Tumors of the Third Ventricle. Johns Hopkins Hospital Bulletin, 1922, vol XXXIII, p 188.

Such tumors could doubtless be removed with greater ease and safety through a defect created by resection of the right frontal lobe

For certain tumors situated deeply in the *right* side of the middle cranial fossa, preliminary resection of the temporal or occipital lobes would be justifiable though of course in such instances contralateral homonymous hemianopsia would result. Section of the *left* occipital lobe posterior to the supramarginal and supra-angular gyri apparently leave no stigmata other than a right homonymous hemianopsia. The inclusion of these sensory speech areas could hardly ever be justifiable even with preservation of life. There is usually no need of a decompression following resection of a cerebral lobe for the defect created by the missing lobe will usually more than compensate the edema which follows

#### SUMMARY

A case is presented of a dural endothelioma (an encapsulated benign tumor) arising from the covering of the cribriform plate, occupying both sides of the cranial chamber to an equal degree. The tumor was completely removed after a preliminary resection of the left frontal lobe. No loss of function of any kind followed the operation. This procedure (resection of a silent cerebral lobe in part or whole) is advocated as a method for the removal of certain intracranial tumors known to be benign and which are situated at such a depth as to be in large part or wholly hidden from view.

The purpose of the method is to provide a good exposure of the tumor so that the brain may not be injured in reaching and removing the tumor, that the tumor may be extirpated carefully, and that bleeding may be controlled deliberately instead of being left to chance.

**B An Intracranial Approach with Concealed Incisions**—The accompanying drawings illustrate a craniotomy approach which was designed to leave the operative scar concealed. Most routine craniotomy incisions, and all in which the frontal lobe or hypophyseal regions are explored, cross the forehead in front of the hair line, leaving scars of varying extent permanently visible. As the hair line recedes naturally the scar lengthens. While careful and painstaking closure of wounds has made scars far less obtrusive, at best they are an unwelcome adornment.

The incision of this approach is not uniform, considerable latitude being allowed owing to the different shapes of the hair line. In a general way, it may be said that two small more or less U-shaped adjoining skin-flaps (Fig. 3) are made instead of a single large one, a middle limb serving both as the back of the anterior and the front of the posterior skin flap. The base of the anterior flap is directed toward the orbit, the base of the posterior downward toward the zygoma backward much as the posterior half of the customary curvilinear craniotomy incision. When exposure of the frontal

# INTRACRANIAL APPROACH WITH CONCEALED INCISIONS

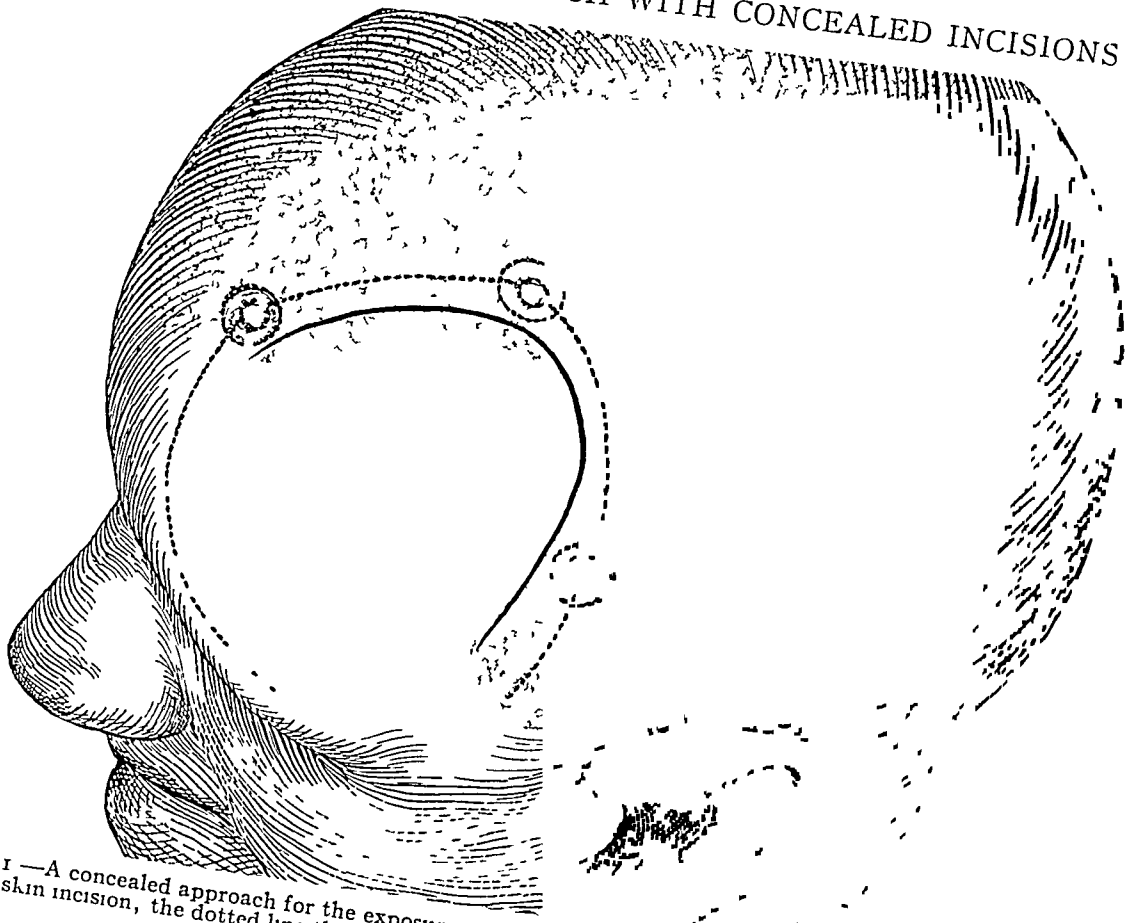


FIG 1 —A concealed approach for the exposure of the frontal lobe alone. The solid line represents the skin incision, the dotted line the bone flap. Such a small flap is used only on special cases.

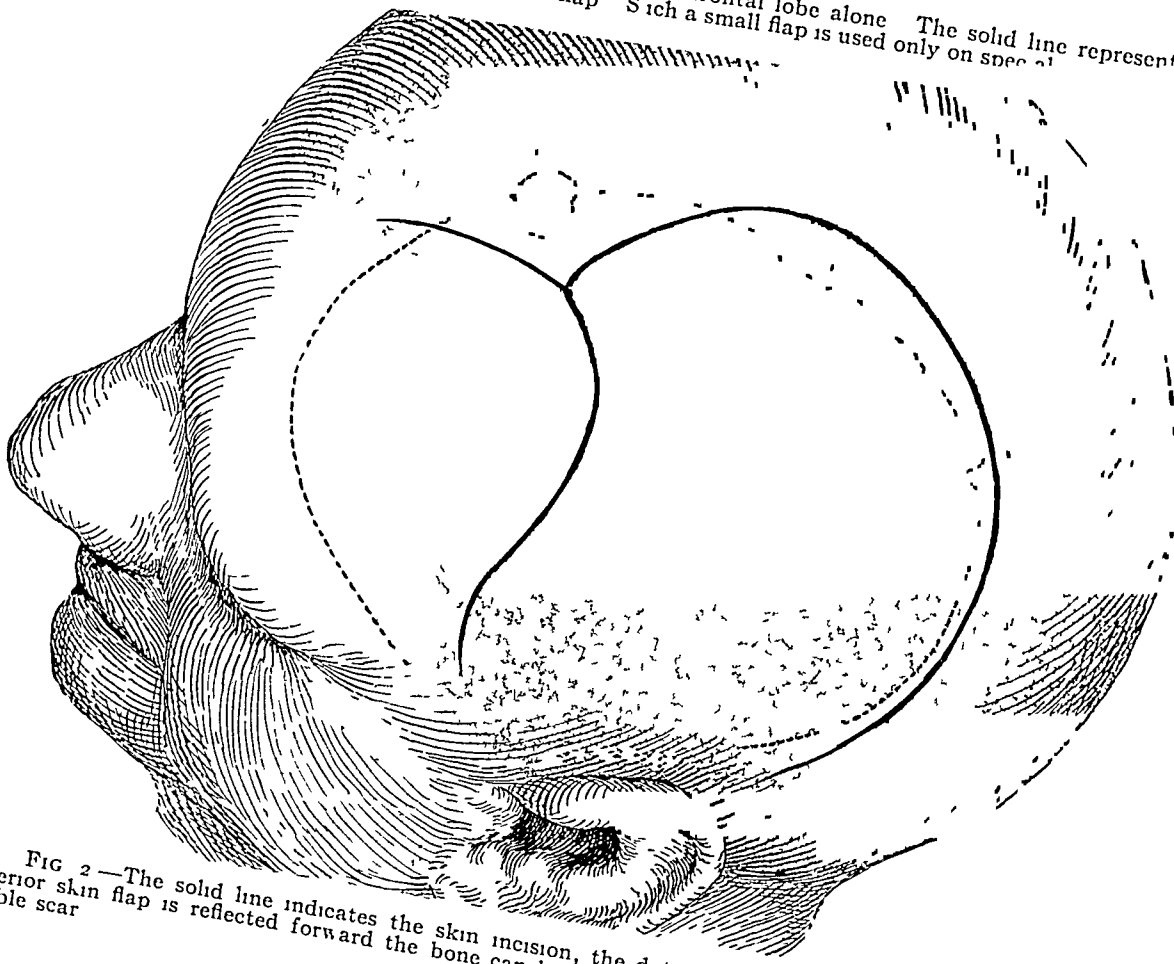


FIG 2 —The solid line indicates the skin incision, the dotted line the bony incision. When the anterior skin flap is reflected forward the bone can be cut almost to the supraorbital ridge without a visible scar.



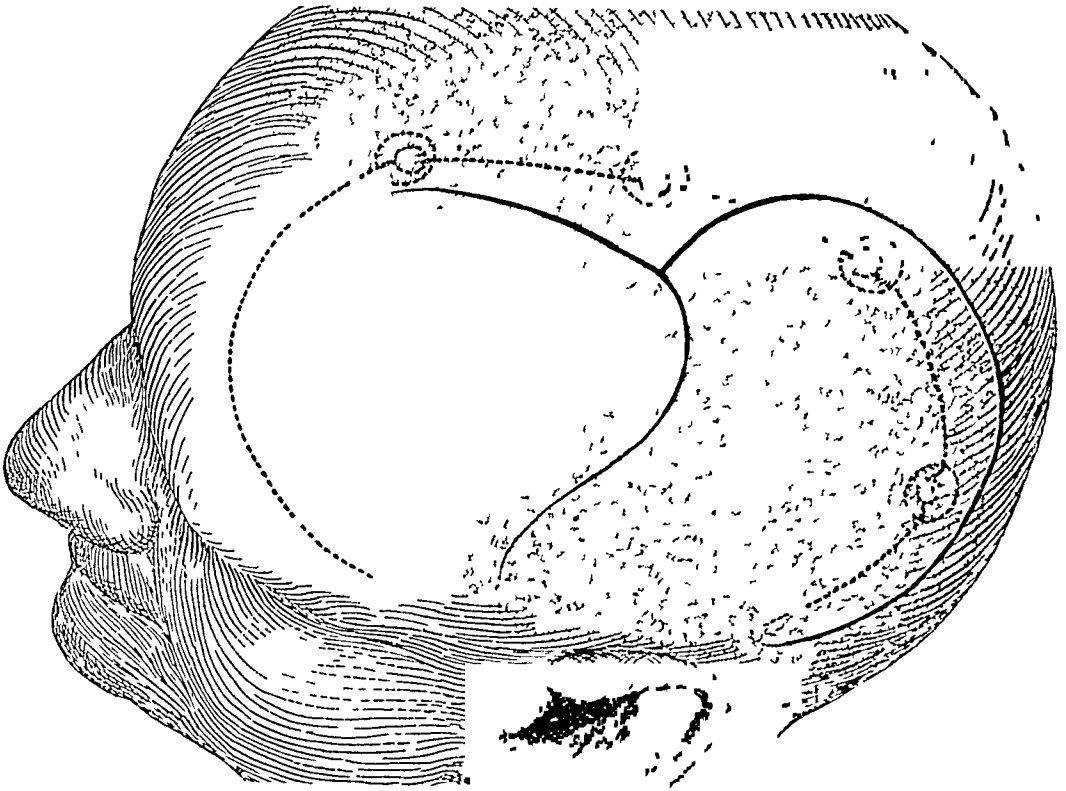


FIG 3 —When the hair line has receded the skin incision can be made to conform to its shape without disfigurement

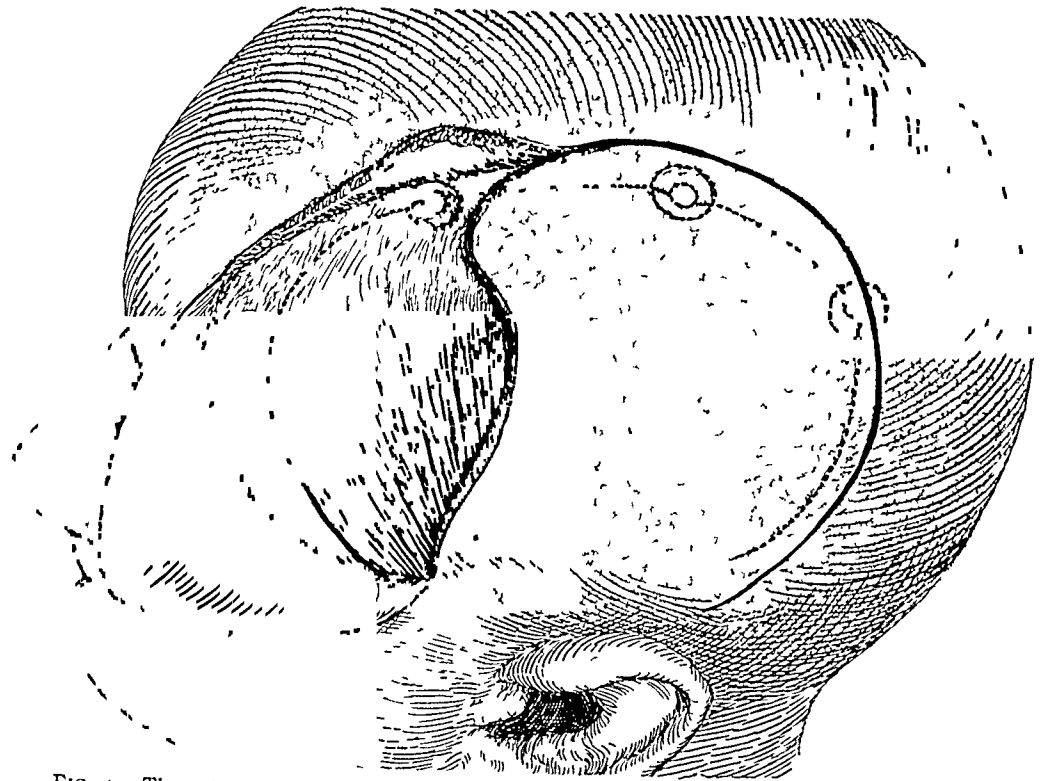


FIG 4 —The anterior flap of skin is reflected showing the temporal muscle attachment. The dotted line indicates the incision of bone and the solid line through the temporal incision indicates where these fibres are divided prior to cutting bone beneath. This approach is used in all hypophysis tumors demanding an intracranial operation

## INTRACRANIAL APPROACH WITH CONCEAIED INCISIONS

region is not desired, the posterior flap outlined and a short straight or curved spur, one to two inches, is projected forward at right angles to its limb (Fig 2) In effect the result is precisely the same, except in degree, as with the foregoing incisions The anterior skin flap is reflected anteriorly, the line of cleavage of the dissection being between the galea aponeurotica and the

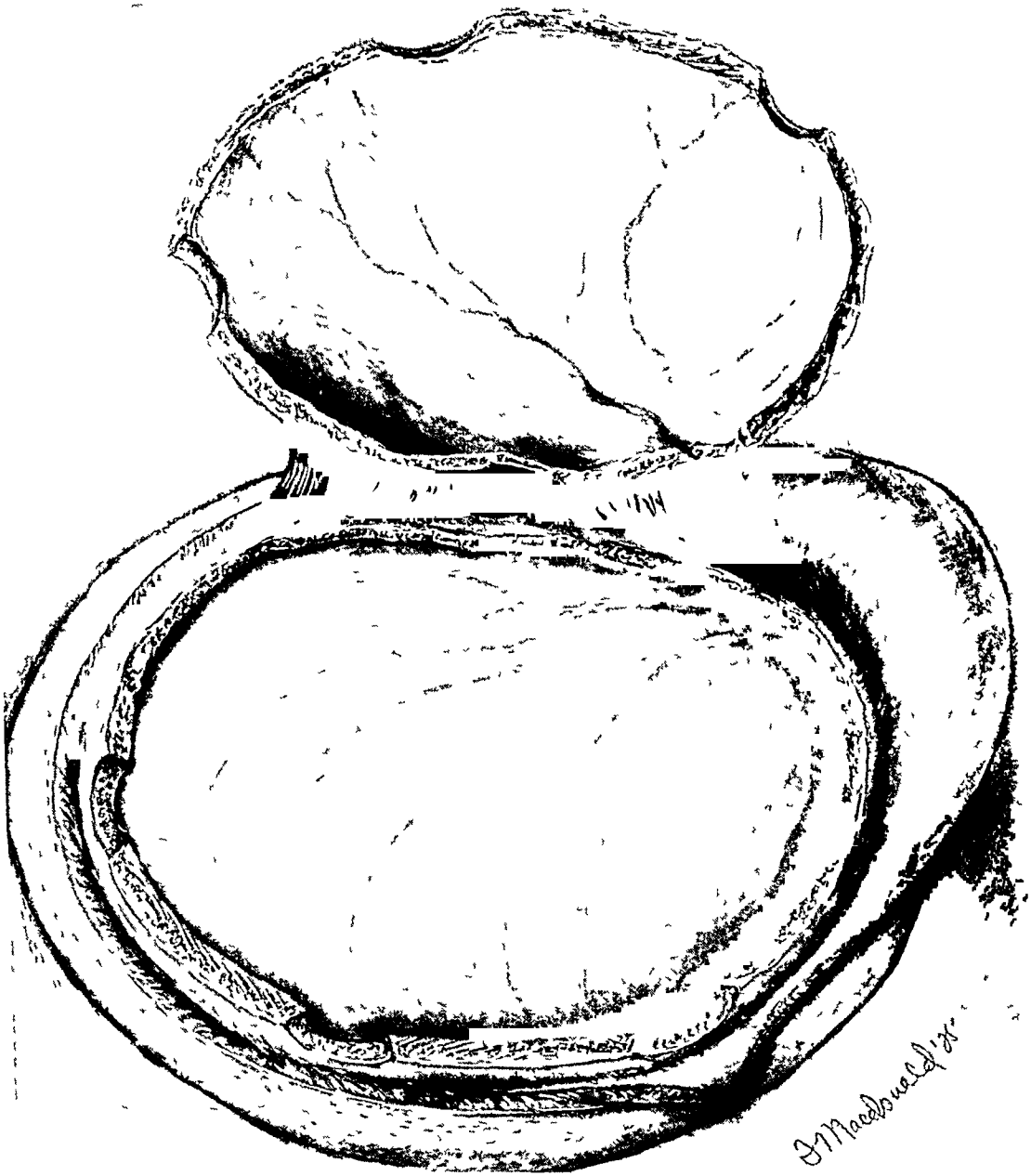


FIG 5 —Demonstrating the end result of the approach drawn in Figs 2 3 and 4

pericranium The posterior flap is reflected later with the bone The temporal muscle is incised parallel to its fan-shaped fibres, anteriorly as far as the reflected flap will permit and posteriorly directly under the skin incision (Fig 4)

The perforator openings in the bone are so placed as to be covered by the hair, thereby avoiding a slight depression which otherwise might follow At times when additional reinforcement of a bevelled edge is advisable, an extra

perforator opening is made anteriorly under the temporal muscle which covers the bony defect

When the hypophyseal region is to be explored it is advisable to carry the anterior limit of the skin incision 1 to 3 cm onto the uncovered forehead (Fig 4) With this additional extension it is possible to reflect the anterior skin flap to the supraorbital ridge and to section the bone at the anterior-most



FIG 6—Showing the scar beneath the hair line when only the anterior flap has been used. In this case a large dural endothelioma was removed from the frontal lobe. Photographed ten days after operation.



FIG 7—Showing the anterior extent of the skin incision in a patient whose entire frontal lobe was resected in two stages.

part of the cranial chamber. I have used this approach exclusively for hypophyseal tumors for several years.

The entire frontal region of the brain can be perfectly exposed by the anterior flap alone (Fig 1). This restricted approach is recommended particularly for tumors involving the frontal bone before the exposure of lesions (other than tumors) of the frontal lobe. Recently this exposure was ample to permit the removal of a large dural endothelioma of the frontal lobe (Fig 6). However, except in unusual intracranial tumors, one desires a maximum rather than a minimum exposure.

It will be noted that in the major approach, much of the incision through bone or dura is not immediately beneath the skin incision. Not only is the possibility of an occasional cerebrospinal fluid fistula thereby made more

remote, but the danger of an accidental skin infection being carried to the underlying bone or brain is of less concern

The approaches mentioned have been used in practically every case (except where the patient was bald) of cerebral tumor or craniotomy for other purposes, for several years. Among the first cases, the angle where the incisions joined occasionally failed to heal perfectly, but with care in preserving the circulation by a painstaking closure at this point there has not since been the slightest defective healing

# RENAL TUBERCULOSIS

A CLINICAL SURVEY OF 295 CASES, 90 OF WHICH WERE NOT OPERATED ON  
BY MAURITZ PERSSON, M D

OF STOCKHOLM, SWEDEN

FROM THE SURGICAL DEPARTMENT OF THE SERAPHIMER HOSPITAL OF STOCKHOLM,  
PROFESSOR J. AKERMAN, SURGEON IN CHIEF

## SYNOPSIS

- I Statistical data
- II Symptomatology survey
- III Post-investigation of non-operated cases
  - 1 Mortality and causes of death
  - 2 Patients surviving and their condition
- IV Post-investigation of operated cases
  - A Nephrotomy and kidney resection
  - B Nephrectomy
    - a Bilateral renal tuberculosis
    - b Unilateral renal tuberculosis
      - 1 Operative mortality and causes of death
      - 2 Late mortality and causes of death
      - 3 Patients surviving and their condition
      - 4 Operative technique and wound healing
      - 5 Bladder tuberculosis its prognostic importance
      - 6 Pregnancy and delivery in nephrectomized women
- V Summary

The present paper is a clinical study of the renal-tuberculosis material obtained at the surgical clinics of the Seraphimer Hospital Stockholm during the period 1890-1920. The year 1920 has been fixed as a limit-year in order to allow of sufficient lapse of time after treatment in the hospital to permit of an opinion being drawn regarding the final results. The diagnoses have in all the cases been determined by (1) Proving the presence of *tubercle bacilli* in the urine either by the microscope or by guinea-pig test, (2) a *histological examination* of the extirpated kidney or (3) by *autopsy*. From the analysis there have been excluded 36 cases operated on during the period in question where the extirpated kidney has, macroscopically, shown tuberculous alterations, but where tubercle bacilli have not been shown in the urine, and where the kidney has not been investigated histologically, or preserved.

## I STATISTICAL DATA

I. Sex.—In the material men are in a great majority. Among those operated on, men are also in the majority, although not to such a high degree, as will be seen from the appended table.

Entire material	295	Men	194 (65.8%)	and women	101 (34.2%)
Operated	205	Men	123 (60.0%)	and women	82 (40.0%)
Not operated	90	Men	71 (78.9%)	and women	19 (21.1%)

## RENAL TUBERCULOSIS

In these figures, consequently, we trace a relative displacement in favor of women in respect to cases that have been operated on

2 *Age*—It is a general observation that chronic kidney tuberculosis is most frequent in the third and fourth decades of life. This circumstance becomes plainly evident in the present material, where more than 64 per cent of the cases fall within the above mentioned age-groups

1st decade	5 cases	5th decade	38 cases
2nd decade	46 cases	6th decade	13 cases
3rd decade	85 cases	7th decade	4 cases
4th decade	104 cases		

The five cases in the first decade were. One in the seventh, three in the eighth and one in the ninth year of age. Chronic kidney tuberculosis is considered to be very rare in this age-group. *Wildbolz*<sup>14</sup>, for instance, among 245 cases did not discover a single instance, and *Blaasch*<sup>2</sup> discovered no more than two in 532 cases.

Subsequent to the fourth decennium we find the frequency rapidly decreasing, and, after the seventh, there is not a single case.

3 *Side*—In the material examined, the cases are divided as follows

Cases operated on	205	Cases not operated on	90
Of these right side	109	Of these right side	15
left side	88	left side	10
both sides	8	both sides	38
		side unknown	27

In some instances, however, our methods of investigation which, unfortunately, are still far from perfect, may have led to a faulty determination in one direction or the other. In four of the double-sided cases, the operation was made with the premise that the tuberculosis was unilateral, and it was not until autopsy that the bilateralism was discovered. It is difficult to say how many of the non-dissected cases, especially the earlier ones occurring in the material, were in reality bilateral when they were operated on, although they had been considered, and were treated as unilateral cases. Even with the resources we have at our command at present, it is probably impossible to discover a very early kidney tuberculosis before pus-cells and tubercle bacilli are discovered in the urine from the kidney in question, i.e., before a closed tuberculous focus has broken into the kidney pelvis. In reality, however, such a source of error is probably not very great. In cases of secondary bilateralism, i.e., where infection of the second kidney has occurred from the first affected kidney, there will probably exist a great possibility of proving alterations in ureter-urine, for we suppose that the spreading to the other kidney usually takes place via a secondary tuberculosis of the bladder and infection ascending along the ureter. Those instances where bilateral tuberculosis can easily be overlooked are, consequently, chiefly the primary bilateral cases. These are, undoubtedly, rare. Chronic kidney tuberculosis most certainly develops as a rule, unilaterally at first, and remains so for a fairly long period<sup>14</sup> \*

With the above reservations, we find in the material at hand, if we neglect the uncertain cases, a determined bilateralism in about 17 per cent of the cases. Of the 33 instances that have proceeded to autopsy, the tuberculosis was double-sided in 12 cases. Of the 16 cases not operated on and that were obducted, 8 were bilateral.

4 *Coincident Tuberculosis in Other Organs*—Although we probably all agree that primary kidney tuberculosis, in the real sense of the word hardly occurs, it is far from the part that in every case of surgical kidney tuberculosis, evidence can be shown of other tuberculous lesions still existing in the patient, or that have healed. A primary kidney tuberculosis presupposes that the tubercle bacilli enter the body without causing any

\* In this material there is an instance which was operated on with ideal results, seven years after the diagnosis of unilateral kidney tuberculosis had been determined. The patient lives and is in good health now 10 years after the operation.

alterations in the entrance, and that they reach the kidney *via* the blood-vessels, without giving rise to any anatomical alterations on their way thither. We do not deny this possibility, but, practically speaking, one manifestation or another of tuberculosis, has, probably, always preceded tuberculosis of the kidneys, although, in many instances, the clinical symptoms of the first may have been so little noticeable that the tuberculosis of the kidney has apparently been primary.

Among 300 patients suffering from renal tuberculosis, who were subjected to complete clinical and roentgenological investigation of the lungs, *Blaasch*<sup>8</sup> discovered signs of pulmonary tuberculosis in the case of 84, or 28 per cent. Tuberculosis of the bones was found in 6 per cent of a total number of 346 patients.

In the material of the Seraphimer Hospital, symptoms of other tuberculous lesions was discovered in 150 patients, or about 50 per cent of the whole number, in accordance with the following table

Pulmonary tuberculosis	66 cases	22.4 per cent
Genital tuberculosis	46 cases	15.6 per cent in men
Bone and joint tuberculosis	21 cases	7.1 per cent
Pleuritis	7 cases	
Lymphadenitis	10 cases	

5 *Hereditary Tendency*—In the 142 cases where positive or negative statements of this factor existed, the occurrence of tuberculosis among relatives was found in 36 cases, and the absence of or ignorance of such tendency in 106. Hereditary tendency could, consequently, be traced in about 25 per cent of the cases. *Lower and Shupe*<sup>10</sup> found a corresponding figure of 29.5 per cent among 61 cases.

## II SYMPTOMATOLOGICAL SURVEY

According to current experience the clinical picture of kidney tuberculosis is multifarious. The subjective troubles first noted by the patients in the present material vary in fairly high degree in different cases. The following table shows their relative frequency.

Slowly progressive, chronic cystitic symptoms	200 (68.5%)
Of which, with hæmaturia	122
without hæmaturia	78
Acute cystitic symptoms	16 (5.5%)
Of which, with hæmaturia	10
without hæmaturia	6
Dull pains in kidney region	27 (9.2%)
Of which, with later cystitic symptoms	21
Renal colic-pains	26 (9.2%)
Of which, with later cystitic symptoms	20
without later cystitic symptoms	6
Initial, fairly great hæmaturia	16 (5.5%)
Of which, with later cystitic symptoms	12
without later cystitic symptoms	4
Sepsis <i>ex abscessu perinephritide</i>	1
Perfectly free from subjective symptoms	6

*Bladder irritability*, consequently, is the most common symptom and was found in 74 per cent of the cases. Then comes *pain in the kidneys* with 18.5 per cent, half being dull pains and the other half of a colic-like nature. The third place is occupied by *hæmaturia*, with 5.5 per cent.

Six of the cases belong to the symptomatologically perfectly indolent type. In one of them, miliary tuberculosis broke out after a fracture of the pelvis, and on autopsy a kidney tuberculosis was discovered. The other five were under observation for other complaints, and kidney tuberculosis was found merely as a result of routine examination.

## RENAL TUBERCULOSIS

During the latter part of the course of the disease, there appeared macroscopic *hæmaturia* in further 45.2 per cent of the cases. On one occasion or another, this was the case in, altogether, more than 50 per cent of the instances. Symptoms of bladder irritability appeared during the latter part of the course in 18.1 per cent of the cases. Thus, such instances occurred in more than 92 per cent of the cases during longer or shorter periods. Among these there was noticed a markedly periodic remittent course in 38.6 per cent of the cases, and an evenly progressive course in the remainder.

*Incontinence* has occurred in, altogether, 8 cases, i.e., in about 2.7 per cent. In two instances, children of from 7 to 8 years of age, this was of a markedly nocturnal type. In the other six, it was different, being both nocturnal and diurnal. In one instance, a woman 46 years of age, whose complaint began as an acute cystitis, such involuntary passing of the urine had continued 19 years, and had not been preceded by any desires to urinate, with the exception of during the very earliest part of the period. During all these years this had constituted the patient's only symptom, with the exception of some slight pains that had been felt on a few occasions in the left side of the abdomen. In three of the instances, incontinence appeared periodically as a symptom of deteriorating chronic cystitis. Two of the patients were men of 26 and 28 years, three were women of 18, 46 and 66 years, and three children between 7 and 12.

In all the cases of incontinence, kidney tuberculosis proved to be in a relatively advanced stage, in five instances bilateral and in the other three unilateral, but with the diseased kidney much tuberculated. Casuistics, therefore, display no instance where incontinence has been an early symptom in the real sense of term, but, on the other hand, it is evident that the mucous membrane of the bladder has not necessarily been macroscopically tuberculated in any very great degree, for there are two instances where alterations of the bladder have been limited to a slight redness or a slight ulceration around one ureteral orifice.

*Polymia*—Although the material is not completely examined with regard to this question, it is evident that, in many instances, the amount of urine has been larger than the normal, in many instances exceeding 2000 grammes per day.

*General Symptoms*—Loss of weight, diminution of vigour, loss of appetite, etc., have occurred in 51 per cent of the cases. The loss of weight has, in most instances, been moderate, only in one or two cases has it exceeded five kilogrammes.

*Urine*—The reaction was acid in 88.7 per cent of the cases, amphoteric in 7 per cent and alkaline in 4.2 per cent. In 11.5 per cent of the cases with acid reaction secondary infection existed, in one half, coli-, and, in the other, strepto- and staphylococci. In 33 per cent of the cases with alkaline reaction there existed secondary infection.

Albumin was found in 97.5 per cent of the cases, 10.2 of which only as traces, but in the rest in to a somewhat more considerable extent, in no instance, however, did it exceed 6 per cent usually one per cent. In 7 cases Heller was negative, after tests 1-3 times repeated. Røvsing<sup>12</sup> has pointed out that, such cases without albuminuria are not so extraordinarily rare. Among 200 cases he found where albuminuria was altogether absent, or where it only appeared intermittently.

The sediment contained pus-cells in every instance, from relatively unimportant quantities to unheard-of masses, in no instance was the amount so small that the pus-cells could be noted as "rare." Microscopic blood, or reliable statements as to the occurrence of blood in the urine occurred in 68 per cent of the cases. The corresponding figures in Crabtree and Cabot<sup>4</sup> was 64.2 per cent.

*Tubercle-bacilli* were demonstrated microscopically in 78.3 per cent of the cases, and by guinea-pig test in a further 7.1 per cent, or a total of 85.6 per cent. In the other instances, the diagnosis has been verified by histological examination of the extirpated kidney. Ekelhorn<sup>13</sup> states that there ought to be no difficulty in demonstrating tubercle-bacilli in 80-90 per cent of the cases.

*Palpable Kidney*—In 76 cases, or about 25 per cent, the diseased kidney was palp-



able, more or less enlarged and, in most instances, quite tender to pressure. In 27 cases, or about 9 per cent, with non-palpable kidney, there was tenderness to pressure or muscle-tension over the place of the kidney. In 6 cases the healthy kidney was found to be palpable but not tender to pressure, while no local symptom could be demonstrated by palpation on the diseased side. Ekehorn<sup>10</sup> and Wildbolz<sup>11</sup> declare this symptom to be a sign of compensatory enlargement. In the majority of cases 63 per cent there existed no external symptoms from the kidneys.

### III POST-INVESTIGATION OF NON-OPERATED CASES

In judging the value of nephrectomy in renal tuberculosis a comparison between the later course of the disease in the nephrectomized and the non-nephrectomized cases is of interest. Among the 90 reliable cases which, as regards the diagnosis, fulfilled the conditions stated in the introduction, but which, for one reason or another were not subjected to nephrectomy, 38 were double-sided, so that there was no question of an operation. In 27 instances it was impossible to decide if the tuberculosis was unilateral or bilateral in consequence of extreme bladder alterations which rendered ureteral catheterism impossible. In 15 cases the tuberculosis was right-sided and in 10 left-sided. In most of these 25 instances no operation was carried out in consequence of the patient's refusal to submit to one. In some few instances operation was contra-indicated by manifest pulmonary tuberculosis in an advanced stage.

1 *Mortality*—Of the 84 cases in which reliable information has been obtained on post-investigation, 71, or *84.5 per cent of the non-operated patients are dead*. Since the beginning of the disease there have died within two years, 26 = 31 per cent, within three to five years, 27 = 32 per cent, within six to ten years, 12 = 14.3 per cent, after ten years, 6 = 7 per cent.

There have thus died within the first five years after the beginning of the disease 63 per cent of the non-nephrectomized cases. For the sake of comparison there is given an investigation by Wildbolz.<sup>11</sup> Of 316 non-operated patients, there died within two years 33.3 per cent, within five years a total of 58 per cent.

A life's-length of more than ten years has been shown in the cases of 12 patients, or 14.3 per cent.

Of the 25 cases of unilateral renal tuberculosis where operation was considered indicated but was not carried out two have not been found. Of the remaining 23, there have died 16 within five years, or about 70 per cent. A total of 19 have died, or 82.6 per cent, a mortality, consequently, which is in very good agreement with that of the whole of the non-operated material (84.5 per cent).

*Causes of Death*—Kidney and urogenital tuberculosis and its sequelæ general cachexy and uræmia are in great preponderance, forming about 80 per cent. Next come acute miliary tuberculosis, with 8.4 per cent, and, finally, a few cases from other causes. Pulmonary tuberculosis, 2. Morbus Addisoni, 1. Tub. peritonei et intest., 1. Cystoscopical injury, 2. Paralysis cordis et CHCl, 1.

## RENAL TUBERCULOSIS

2 *Surviving Patients* —Of the 13 surviving cases, one of which has been observed for 27 and six for more than ten years, five have been personally examined by the present writer. The remainder have sent in written detailed replies respecting their condition. The following groups are distinguished:

a *Unimproved and Worse* —Of the 8 cases in this group, 6 were bilateral with pus-cells and tubercle bacilli from both ureters, one was unilateral with healthy urine from the one ureter, and, finally, one unknown if the case was uni- or bilateral (only one ureter catheterized, and in the urine from this there were discovered pus-cells and tubercle bacilli). The longest period of observation since the beginning of the symptoms is fourteen years, the shortest four.

A common characteristic of all these cases is that the symptoms continue to trouble the patients just as much as, or more than, they did during the stay at the hospital. At the time when the patients were post-examined, they were not fully capable of working. The weight is unchanged, or displays some little increase. The desire to urinate is frequent, as much as twice in the hour. In all the cases but two, there still occurs a smarting pain on urination. The urine is now and then mixed with blood, but otherwise usually clouded. In the three instances that the present writer has had the opportunity of examining personally, there were still found tubercle bacilli in the urine, together with pus-cells. In the single instance in which the writer has had the opportunity of making a cystoscopic examination, there was discovered considerable bladder alterations, which rendered ureteral catheterization impossible. One of these cases is of interest insofar that, for more than three years it displayed an increasing improvement in all the symptoms, and then afterwards grew worse. This was the only instance of unilateral tuberculosis in this group.

b *Subjectively Improved* —This group includes three cases, none of which was determined as bilateral. The period of observation 21, 15 and 12 years, respectively. None of these cases has been investigated by the writer personally, but his statements are based on the written information supplied by the patients.

A common feature of the cases is that the symptoms continue in a more or less marked form, although more slightly than during the patient's stay at the hospital. The patients are either quite capable of work, or almost so. Two of them have increased in weight, one is of the same weight as at the hospital. The urine is stated to be clear, and, excepting for a short time after the patient's leaving the hospital, has been free from blood. The desire to urinate occurs once every three or four hours. During the last few years, urination has caused no smarting. It is stated that tuberculosis has not appeared in any other form since the stay at the hospital. The urine has not been examined for tubercle bacilli nor has a guinea-pig test been made.

c *Subjectively Restored to Health* —This group of non-nephrectomized cases, which is of importance from many points of view embraces two cases, both unilateral. The period of observation, from the beginning of the

symptoms, is 27 and 17 years, respectively. In both instances, the writer has had an opportunity of carrying out personal post-investigations, supplemented by guinea-pig tests of the urine.

Common to both cases is, that the subjective symptoms have disappeared without a trace. On examination, the patients were found to be perfectly able to work, they have increased, respectively, 13 and 9 kilogrammes in weight. Desire to urinate, normal, three times a day, 0-1 at night. No pains on urination or otherwise. The urine clear, never blood-colored during the last few years. No albumin in the urine, nor any tubercle bacilli or other bacilli. In the one instance there were some few leucocytes, in the other, no sediment. The guinea-pig test in one case (the oldest) resulted negatively, in the other positively.

As these cases are worthy of interest, a summarized history of the illness is here appended.

(1) Female, twenty-four years of age (11/7/1897). Diagnosis *Febren dit*. In September, 1896, there occurred at intervals of some days, an aching in the region of the right loin and the bladder, accompanied by vomiting, frequent desire to urinate, and cloudy urine. In December, 1896, sharp pains in the abdomen on urination, and, occasionally, blood in the urine. The symptoms continued with varying intensity until admittance to hospital, February 6, 1897. Status: Good general condition. Pale. Temperature  $37^{\circ}/38^{\circ}$  C. Frequency of urination was every third hour by day, and a couple of times by night. The right kidney palpable somewhat enlarged, tender. Amount of urine daily 2000 ccm. Urine cloudy, slightly acid, traces of albumin. Large numbers of white blood-corpuscles and numerous tubercle-bacilli in the sediment. The patient was treated with salol, 1 gramme three times daily, and lavation of the bladder with lapis infernalis solution. Discharged March 13, 1897, subjectively improved. Pains in the right side then less severe, desire to urinate slighter and less frequent, urine clearer. A couple of months after discharge from hospital, the desire to frequent urination and the smarting pains disappeared and the urine became crystal-clear. Since then, there have been no difficulties with regard to urination. In 1921, occasional symptoms of ulcer duodeni. Admitted to the medical clinic 1 (Prof. I. Holmgren) July 3, 1922. Röntgenological determined ulcer-recess in duodenum. July 12, hematemesis of about one litre blood. Discharged August 23, for further attendance at home. No improvement. Readmitted to medical clinic January 10, 1923. Right kidney palpable. Urine acid. Heller negative. In sediment, fairly large numbers of white blood-corpuscles and coli-bacilli. No tubercle bacilli. Guinea-pig test negative. January 19. Cystoscopic examination: bladder contents 300 ccm. Walls of bladder pale and without ulcerations or granules. Left ureteral orifice without remark. Catheter enters about 30 cm. Right ureteral orifice could not be found. In urine sediment from left ureter a few red and white blood-corpuscles, and a very few coli-bacilli. 5 ccm 0.4 per cent indigocarmine solution injected intramuscularly. After a quarter of an hour there ran from the left ureter a blue-green colored urine. From the place of the right ureteral orifice there came no colored liquid. Röntgen examination of kidneys: Right kidney shadow is considerably smaller than that of the left and has an irregular lobate form. Its greatest breadth is about  $5\frac{1}{2}$  cm. No calcification demonstrable within it. Here there occurs an evident shrinking of the right kidney and, probably, a compensatory hypertrophy of the left. After examination September 17, 1923, the patient is still without any urination troubles. Increased 13 kilogrammes in weight. Urine clear, without any other pathological constituents than a few white blood-corpuscles. Right kidney palpable, appears to be enlarged. Left kidney not palpable.

## RENAL TUBERCULOSIS

Here, then, we have a case of a woman, twenty-seven years ago, when twenty-four years old, previously healthy, gradually displayed symptoms of urinary affection, which, on examination about a half year later, proved to be renal tuberculosis, probably right-sided. No catheterization of the ureters is undertaken, but, from the clinical symptoms—right-sided pains in the kidney, and a palpable, enlarged right kidney—the assumption of a right-sided localization is plausible. After about one month's lunar-caustic-lavation of the bladder, the patient is discharged from the hospital, an operation having been declined by her. After a couple of months more, but without treatment, all symptoms disappear forever. On examination, twenty-seven years after the beginning of the sickness, the patient is still free from all subjective urinary troubles, the urine is perfectly normal, with the exception of a small number of pus-cells in the sediment and a similarly relatively innocent coli-infection in the urine. A cystoscopic examination shows the bladder to be normal, the right ureteral orifice cannot be discovered, however, and no urine is obtained from the right kidney on a function-test with indigocarmine. The right kidney is still palpable and somewhat enlarged. A roentgen examination shows in the place for the right kidney a dense shadow of the shape of a kidney, but of somewhat larger dimensions. The guinea-pig test for tuberculosis is negative in the urine.

Are we here entitled to speak of a genuine spontaneous healing of the kidney tuberculosis? The observation-period is long, twenty-seven years. All subjective troubles have disappeared. The disappearance of the tubercle bacilli from the albumen-free urine is demonstrated by animal-test. But there is no proof that the previously tuberculous kidney has retained its powers of functioning. On the contrary, the result of the examination now seems to point to that kidney having altogether ceased to act. Consequently, everything seems to point to our having a case of so-called *autonephrectomy*, where the diseased kidney, after a greater or less destruction of the parenchyma of the kidney, has been cut off from communication with the bladder by a cicatricial stricture of the ureter, whereby the further spread of the tuberculous process into the urinary system has been prevented.

As such a closed, but not in the real sense of the term, healed kidney formed a constantly present danger of the spread of tubercles (Wildbolz<sup>14</sup>), an operation was proposed to the patient (nephrectomy) but she refused to submit to it. The final and conclusive evidence that we have here a case of autonephrectomy—an anatomico-pathological examination of the extirpated kidney is, consequently, impossible to obtain.

(2) Male, fifty-one years old (1559/1919) Diagnosis *Tbc ren um*. Ever since 1906, increasing urinary troubles, more frequent desire to urinate, even at night smarting pains in the urethra at the beginning and close of urination, and cloudy and albuminous urine. The trouble continually increased to such a degree that the patient, during the last few years before admittance to the hospital, had been obliged to urinate 3 or 4 times an hour, both night and day. On several occasions there was much blood in the urine, partly diffuse, partly coagulated. Some sense of fatigue, but no diminution in weight. No pains in the kidneys. Latter, subjectively somewhat improved. Admitted June 2, 1919. Status Good general condition. Kidneys not palpable nor tender. In urethra, 15 cm behind its orifice, a 3 cm long, relatively slight stricture. In the peri-

neum, corresponding to the place of the stricture, there is palpated a somewhat thickened and hardened part of the urethra, not tender to the touch. Prostate and exterior genitalia, in other respects without remark. Urine somewhat cloudy and acid. Heller's test positive. Large numbers of pus-cells, but few red blood-corpuscles in the sediment. Tubercle bacilli demonstrated. Guinea-pig test for tuberculosis positive. *Cystoscopic examination*. The bladder receives with tension 100 ccm. Right ureteral orifice soft and thin-walled. Catheter introduced into the right ureter as far as up to the rectal pelvis. In the left ureter, the catheter met with an obstacle 2 cm from the orifice. No urine was obtained. The urine from the right ureter almost clear, acid. Heller's test positive. In the sediment a few pus-cells, a larger number of red blood-corpuscles, a few tubercle bacilli. As bilateral kidney tuberculosis was considered to exist, the patient was discharged unimproved June 17, 1919. After returning home the patient at first grew worse. He could not retain his urine more than 10 minutes at a time, either day or night. Was unable to work. Late in the autumn of the same year, he began to slowly grow better. His strength gradually returned, at night he could retain urine for an hour, the urine grew clearer after having previously been of a milky-white, the painful desires to urinate diminished. During the following years, grew better and better, the urine became perfectly clear, the frequency of urination diminished to the normal and the patient felt perfectly well and could resume his work to its full extent. On a post-examination, April 11, 1924, the patient appeared to be in very good general health, flesh ordinary (increased 9 kilogrammes) muscular system vigorous, good appetite, in a word subjective health. Kidneys not palpable nor tender. Prostate and seminal vesicles without remark. In the right cauda epididymitis a slight induration. The urine crystal-clear, acid. Heller negative. In the sediment no white or red blood-corpuscles or cylinders, no tubercle bacilli or other bacteria. *Guinea-pig test for tuberculosis positive*. *Cystoscopic examination* was declined by patient as he felt perfectly well. Röntgen examination of kidneys showed no evident alteration of the kidney-shadows.

A man, thirty-eight years of age thus gradually falls ill with urinary troubles, frequent desire for urination smarting in the urethra in urination, cloudy urine, sometimes blood-colored. The illness continues with certain variations in intensity, which, on the whole gradually increases, for thirteen years, after which the patient is admitted to the surgical clinic. Pus-cells and tubercle bacilli are demonstrated in the urine. On cystoscopic examination there are found slight alterations of the bladder and diminished bladder-capacity. In the left ureter a hindrance 2 cm above the orifice, no urine from the left side. The right ureteral orifice normal. In the urine from the right side a few pus-cells and a very few tubercle bacilli. It was assumed that it was a case of bilateral renal tuberculosis, and the patient was discharged without a request for operation being addressed to him. Some months after the patient's returning home there begins a continuous improvement of all subjective troubles without any treatment of the complaint. After about a year, the patient is subjectively perfectly restored to health. After about another three years of subjective health the patient feels himself perfectly well, and the urine is in all respects normal. The guinea-pig test gives however, undoubtedly a positive result.

Although in this case, all trouble has ceased for a relatively long time and the urine has become clear, free from albumin, pus-cells and microscopically demonstrable tubercle bacilli and other bacteria, it is evident that we

## RENAL TUBERCULOSIS

cannot here speak of a spontaneous healing of the kidney tuberculosis. Apart from the fact that here is no evidence that the previously diseased kidney has resumed its functions, the positive guinea-pig test shows, on a post-examination that the tuberculous process in the urinary organs is not cured. In this instance, too, the most likely explanation of the patient's subjective and apparent healing is an encroachment of the diseased kidney before any considerable alteration of the bladder had taken place, or, at any rate, not more than that it could be healed after such an encroachment of the affected kidney. Although, on the post-examination being made, the patient refused to submit to a cystoscopic examination, still, from the absence of albumin and white blood corpuscles in the crystal-clear urine, we are, most probably entitled to suppose that there now exists no alteration of the bladder. It is impossible, however, to express an equally well-founded epicritical opinion respecting the case. It seems to be most probable that the left kidney has always been, and still is, tuberculous. Possibly it is undergoing autonephrectomy, and that the ureter catheter find from the right kidney in 1919, which was interpreted as positive, was the result of an incorrect deduction (cf Wildbolz's opinion, 1913<sup>14</sup> "Es können aus der infizierten Blase Tuberkelbazillen in den gesunden Ureter verschleppt werden, das beweisen mehrere in der Literatur mitgeteilten Beobachtungen").

### IV POST-INVESTIGATION OF OPERATED CASES

The indications for operative treatment that have been followed have, as a rule, been that which are now generally acknowledged by surgeons, *viz* nephrectomy in every case of unilateral, chronic kidney tuberculosis, where the kidney of the other side can be considered as functioning sufficiently, and where there is an absence of definite contra-indications. Independent of exploratory operations, 205 cases have been subjected to operation, nephrotomy in seven instances and nephrectomy in 198.

*A Nephrotomy and Kidney Resection*—These seven cases belong to the earliest among the material. In three there were present great pyonephrosis, and in one a rather large perinephritic abscess. The condition of the other kidney was not known with certainty. In one instance, with tubercle bacilli and pus-cells from the one kidney, and healthy urine from the other, the kidney on operation was found macroscopically normal both on the surface and on section being cut through the kidney. The kidney was therefor allowed to remain after the pelvis had been drained. In two instances, finally, the macroscopic alterations were restricted to a few small granules in the upper pole of the kidney which were removed by resection. Result: 6 died within five years after the operation, one is still alive, 16 years after operation, and feels perfectly healthy. A post-examination made by the writer gave no signs of any disease of the urinary channels (the patient refused to submit to cystoscopic examination, however). This was the same case where, as remarked above, the macroscopically normal kidney was left, so that, to a certain extent, this case is dubious. Experience does not nullify Wildbolz's<sup>14</sup> opinion with respect to nephrotomy in the case of kidney tuberculosis. "Die ab und zu durch diesen Eingriff erzielten Besserungen des Leidens waren nie von langer Dauer, immer nahm der tuberkulöse Process in der Niere nach kurtzer Pause seinen Fortgang."

*B Nephrectomy in Bilateral kidney tuberculosis*—The indications for nephrectomy in bilateral kidney tuberculosis are scanty. Ekehorn<sup>15</sup> considers that the kidney most

attacked should be removed if, by its presence, it is evidently injurious to the patient (e g, in the case of pyonephrosis and toxin-resorption, great pain and repeated hæmaturia), and this even if the tuberculosis in the other kidney is not in an early stage. This if the condition of the patient, in other respects, allows of this being done. Kidney-insufficiency need hardly be feared as the healthier kidney has already been undertaking most of the work of the diseased one. Braasch<sup>2</sup> is of a somewhat divergent opinion. "Unless one kidney is largely destroyed and the other is in fair condition, operation should not be considered, and then only when infection, pain, or possibly hemorrhage renders it imperative." Wildbolz<sup>14</sup> is extremely sceptical as regards operation in the case of bilateral, although he considers it justified under certain circumstances.

The result of our cases of nephrectomy in bilateral renal tuberculosis is not calculated to encourage extended indications for operative treatment. Eight patients with bilateral renal tuberculosis have been operated on during the years covered by the investigations, and the eight patients have died, all within two years after the operation, two from miliary tuberculosis, 1½ and 16 months, respectively, after the operation (autopsy), one of general tuberculosis and amyloidosis 5 months after the operation (autopsy), one with extensive pulmonary—laryngeal—intestinal and bladder tuberculosis and pelvic and perineal abscess 3 months after operation (autopsy) and finally, four from general cachexia and uremia from 7 months to one year and 10 months after operation.

b *Unilateral Renal Tuberculosis*—1 *Operative mortality*. It is clear that, within a fixed material, this will vary according to the length of the period which has been fixed as the limit between operative mortality and late mortality. This period has, in the literature, been stated very differently, and varies between one and six months after operation. Israel,<sup>7</sup> for instance, gives for a collected material of 1023 cases an operative mortality within six months of 12.9 per cent. He considers the deaths within six months to be the result, for the most part, either directly or indirectly, of the operation. Acute miliary tuberculosis, for instance, which during this period appears in almost twice as many cases as in the total of the following years, should, consequently, be the result in most instances of careless manipulation of the kidneys, or of the operation-wound becoming infected by the contents of a tuberculous abscess. Wildbolz,<sup>14</sup> on the contrary, states that the endovesical examinations preceding the operation should bear a part of the blame for appearance of acute miliary tuberculosis, especially in consequence of lesion of the tuberculous seats which often occur in *pari posterior methæ*. In support of this opinion we have the fact that the greater number of the post-operation miliary and meningeal tubercloses attack men. Among 445 cases of nephrectomy, Wildbolz observed an operative mortality within six weeks of 2.4 per cent.

Braasch,<sup>2</sup> with 2.9 per cent, Crabtree and Cabot<sup>4</sup> with 3.8 per cent, and Lower and Shupe,<sup>10</sup> with 2.3 per cent operative mortality include therein the deaths occurring within the hospital where the patient is under observation, independently of the space of time that has elapsed since the operation. Kummell,<sup>9</sup> following the same rule, reports 7 per cent operative mortality.

It seems to the present writer that the most correct way is to follow the last-mentioned method of calculation. The fixing of a certain period would allow all too many possibilities for unforeseen contingencies. As a matter of fact, however, all the deaths in our material that took place within six months

## RENAL TUBERCULOSIS

after the operation happened while the patients were still at the hospital, with the exception of one who died of miliary tuberculosis seven weeks after being discharged. This makes the operative mortality almost identical whether we adopt Israel's method of calculation, or that of Braasch and the others.

The size of the various mortality-groups is seen by the following table

Operations for unilateral renal tuberculosis	190	
Operative mortality	14	7.3%
Patients with complete post-operative data	182	
Died after discharge from the hospital	45	24.7%
Of these, within three years after operation	21	
later than three years after operation	24	
During the 1st year after operation	5	
During the 2nd year after operation	9	
During the 3rd year after operation	7	
During the 4th year after operation	4	
During the 5th year after operation	4	
During the 6th year after operation	6	
During the 7th year after operation	2	
During the 8th year after operation	1	
During the 9th year after operation	1	
During the 11th year after operation	2	
During the 14th year after operation	2	
During the 16th year after operation	1	
During the 18th year after operation	1	

The operative mortality calculated for all the thirty years embraced by the investigation, amounts, consequently, to 7.3 per cent. Various writers have pointed out, however, that the operative mortality has shown a great tendency during the last few years to sink, as both diagnoses and operative technics grow better. During the last five years included in the present writer's investigations, there have been carried out 85 cases of nephrectomy for unilateral renal tuberculosis, with an operative mortality of 4 cases, or 4.7 per cent.

These figures appear relatively high compared with those of Braasch, Crabbtree and Cabot, and with the statistics given by Lower and Shupe,<sup>2, 4, 10</sup> but it must be remarked that, in general, the patients have had to remain a fairly long time at the hospital after the operation. Only one patient died within six months after the operation after discharge from the hospital. Within the lapse of one year after operation, only four more patients had died. These five deaths within the first year constitute 11.1 per cent of the late mortality. For the sake of comparison there are given the corresponding figures from Braasch's investigation<sup>2</sup> which, after the deduction of the operative mortality, amounts to 52 per cent of the late mortality.

The operative mortality among men is considerably greater than that among women, the figures being 9.5 per cent and 4 per cent, respectively.

*Causes of Death in Operative Mortality*—In two instances uræmia, five and two days, respectively, after operation. In neither instance had ureteral catheterization been carried out. Both cases belonged to the very earliest



within the material, and no similar instance has occurred since. In the one case autopsy showed an almost complete aplasia of the second kidney, and, in the second, thrombosis of vena renalis on the healthy side. Wildbolz<sup>11</sup> points out that the post-operative uræmia during the last few years has diminished so greatly in frequency that it is scarcely necessary to take the danger of such a complication into calculation if, before nephrectomy, it is possible to carry out a searching examination of the patient. In 1913, out of 175 cases of nephrectomy, he had but one instance of uræmia, in 1921, out of 270 fresh cases, not a single one.

In 5 cases tuberculosis in one form or another was the direct cause of death, viz. acute military tuberculosis in two instances (one man and one woman who died two to three months after operation), pneumonia caseosa in two instances and peritoneal and intestinal tuberculosis in one. In all the cases except one autopsy was made. In this last instance, military tuberculosis was found by means of Röntgen examination of the lungs.

In two cases acute pneumonia, and in three heart complications, were considered to be the cause of death (autopsy). In one case there appeared a duodenal fistula in the operation wound and the patient died of inanition two and one-half months after operation. Finally cause of death in one case two weeks after operation, was retroperitoneal phlegmon, starting from a rather large abscess in operation wound, which in spite of incision and drainage from lumbar incision, dissected itself down along ureter to the pelvis and perineum.

2 *Late Mortality*.—No case has been observed a shorter time than three years after operation. In this respect this analysis differs from most of the others in this question. One year is the writer thinks all too short a period to allow a reliable opinion being passed with respect to late mortality. According to Israel<sup>7</sup> about one-half of the cases of late mortality occur within two years after operation. The present writer's examinations go to show that about one-half occur within the first three years. Three years, therefore, appear to him to constitute a suitable minimum observation period. Seven of the cases of late mortality occurred within the last two years of the three-yearly observation period—in 1922-1923. Had the examination been carried out two years earlier, i.e. with only one year's observation time the late mortality would have been 4 per cent less. In Israel's collected statistics, the total mortality was about 25 per cent, but he remarks that this figure should, in reality, be larger, for, of the numerous cases that have been under observation only for a short period, many die later on. Like Israel the present writer neglects the accidental cases of death, which are not connected with the fundamental affection, and which are four in number. One of *cancer mammae* thirteen years after nephrectomy (on post-examination at the Seraphimer Hospital, nine years after nephrectomy, the patient had been considered to be cured of affections of the urinary organs), one of *cancer ventriculi*, twelve years after nephrectomy (examined here five years after the operation and then found well), one of *vitium cordis incompen-satum*, seven years after nephrectomy (slight incompen-sation already at the time

## RENAL TUBERCULOSIS

of operation, two years after operation, the post-examination showed no signs of tuberculosis of the urinary organs, (the guinea-pig test not carried out, however), and, finally, one of *ulcus ventriculi*, eleven years after operation, after which the patient had been subjectively perfectly free from all tuberculosis of the urinary system for several years

The late mortality, therefore, embraces all the cases of death after discharge from the hospital and temporary improvement subsequent to the operation—caused by tuberculosis in various organs or by disease in the remaining kidney, inclusive of the non-tuberculous. Of the 182 cases with exact post-operative data, 45 are dead, *i.e.*, 24·7 per cent late mortality. Of these, 31 were men and 14 women. Late mortality, like operative mortality is greater in the case of men than in that of women, or 28·4 per cent as against 19·2 per cent, respectively. This is, probably, connected with the relatively common occurrence of genital tuberculosis in men as shown above.

*Causes of Death within Late Mortality*—There are essentially three great groups of diseases causing the death of nephrectomized patients at a later stadium, when the operating trauma must be considered as having ceased to act as a contributory cause of death. They are *diseases of the remaining kidney, pulmonary tuberculosis and miliary tuberculous processes*.

<i>Died within four years</i>	24
Of which, of disease in remaining kidney	12
of pulmonary tuberculosis	7
of miliary tuberculosis	5
<i>Died after four years</i>	21
Of which, of disease in remaining kidney	9
of pulmonary tuberculosis	9
of miliary tuberculosis	1
of spondylitis with paraplegia	1
of peritoneal tuberculosis	1

The largest group consists of *diseases of the remaining kidney, i.e.*, 44·4 per cent of the cases of the late mortality. In Israel's collected statistics the corresponding figure was 40·5 per cent. In one instance the cause of death was nephrolithiasis. The patient had survived nephrectomy sixteen years and was perfectly cured of his renal tuberculosis, this being demonstrated at the hospital here by examination seven years after operation. In the remaining 20 cases, the cause of death was urogenital tuberculosis. In four of these instances it seems probable that a new, hæmatogenic infection of the previously healthy kidney had arisen several years after nephrectomy, for, by a complete cystoscopic examination and ureteral catheterization, it had been demonstrated before the operation that the urine from the other kidney had been healthy and without tubercle bacilli and pus-cells, and that, in two of the cases, the bladder alterations had been confined to a limited redness and swelling and, in the other two instances, to a very few miliary granules or ulcers, respectively. Three of the cases were operated on in 1910 and 1911. On post-examination in 1913 there remained in them no other symptoms than a somewhat increased desire to urinate. There was no albumin in the urine.

and no pathologic sediment. The alterations in the bladder were perfectly cured. Later on there appeared increased symptoms, and the patients died in 1917, 1918 and 1921. In the fourth case, operated on in 1914, the patient was subjectively quite healthy for several years. In 1918 there was no albumin and no pathologic sediment. The bladder tuberculosis cystoscopically healed. Later on there reappeared typical symptoms, with mictus, 1922, at another hospital, of kidney tuberculosis and uræmia.

In the other 16 instances it would seem more probable that the other kidney, if healthy on the occasion of the operation, had become infected from the bladder, the tuberculosis of which, instead of healing, had increased after nephrectomy.

In 22 per cent of the nephrectomized patients, consequently, a new kidney tuberculosis seems to have appeared after operation. Israel's corresponding figure was 16 per cent.

*Pulmonary tuberculosis* has been the cause of death in 35.5 per cent of the cases. Israel's corresponding figure is 43.2 per cent. The greater mortality caused by kidney tuberculosis as compared with pulmonary tuberculosis is combated by Wildbolz, 1913,<sup>14</sup> when he states that he has only once observed tuberculosis in the second kidney as the cause of death, and that the absolutely greatest part of the late mortality is due to pulmonary tuberculosis. On renewed post-examination of 125 cases ten years after the first,<sup>15</sup> it proved, however, that, of the 104 instances of which he had succeeded in obtaining information, 40 had died (in addition to the operative mortality of four cases) within the course of the following years, *viz.*, 14 of urogenital tuberculosis, "mostly tuberculous disease in the secondary kidney", 13 of pulmonary tuberculosis, 6 of meningitis, 1 of tuberculous peritonitis, 1 of spondylitis, and 5 of intercurrent illnesses. On the whole, therefore, in Wildbolz's statistics, too, diseases of the second kidney have proved to be a threat to the future health and life of the nephrectomized patients in quite as high a degree as pulmonary tuberculosis.

The *multiple tuberculous processes* come third, with 13.3 per cent. Israel's corresponding figure<sup>7</sup> was 13.2 per cent. Of the six cases in the present writer's material, two occurred in the first year, one in second, two in fourth and one in sixth after operation. Three were men and three women.

In one instance, the cause of death was spondylitis, the existence of which was manifest already when the operation was performed, it afterwards increased and caused death fourteen years later, in the shape of a paraplegia, paresis of the bladder and cystopelvis non-tuberculosa. Finally, in one case, death was caused by *peritoneal tuberculosis* three years after operation, and subsequent to a considerable improvement of the symptoms from the urinary organs. On the occasion of the operation, there had been found cystoscopically in the bladder only a single granule in the vicinity of one of the ureteral orifices. In the urine from the healthy kidney no pus-cells had been found, and the guinea-pig test there had given a negative result.

3 *The Condition of the Survivors*—As the requirements that should

## RENAL TUBERCULOSIS

be put forward in order to obtain a satisfactory definition of the expression, "a definite cure of renal tuberculosis by nephrectomy," are given so differently by different writers, it is extremely difficult, in the individual case, to give a definite opinion in this respect, above all, as regards the patient's prospects for the future Wildbolz<sup>14</sup> says in this respect

"Der Schwund der Krankheitsbeschwerden und das gute Befinden des Kranken geben noch nicht die Berechtigung, an Heilung zu glauben. Es muss erst erwiesen sein, dass der Urin eiter- und bazillenfrei geworden ist. Aber auch dann darf noch nicht von definitiver Heilung gesprochen werden, bevor diese Besserung des Zustandes des Kranken längere Zeit, mindestens 3 Jahre lang andauert hat und auch alle ausserhalb der Harnorgane gelegenen Tuberkuloseherde geheilt oder wenigstens latent geworden sind. Nicht alle Chirurgen stellen an den Begriff der Heilung die gleich strengen Anforderungen und es ist deshalb auch nicht möglich, die mitgeteilten Statistiken über die Dauerheilungen der Nierentuberkulose in einer einheitlichen Sammelstatistik zu vereinen."

In an analysis of the present kind, it is, for practical reasons, probably impossible to make such strict conditions for the definition, "cure." In scarcely one-half of the surviving cases has it been possible for the present writer to make a personal examination, and, for the remainder he has had to be satisfied with written replies to the question-form sent to the persons in question. In most instances, statements of patients respecting their subjective condition, are supplemented by examinations of the urine by doctors.

*Recovered*—As "well" have been put down those patients who, three years or more after operation, have been found free from troublesome desires to urinate\*, smarting pains on urination† considerable pyuria‡ and hæmaturia,|| and who have, besides, almost totally regained their strength and power to work¶ and, finally, have increased in weight§.

In addition, the requirement has been made that no sign of tuberculosis

\* In 66.1 per cent of the survivors, with frequent urination before operation, this symptom still continues, in one-half the cases, however, so slightly as one urination nightly. In 12.6 per cent the frequency is more than twice nightly. In 33.9 per cent there is no urination at night.

† In 82.2 per cent of the survivors, there occurs no smarting on urination. In 17.8 per cent the smarting still continues, but of these, in only one-seventh of the cases is the symptom constant.

‡ Seventy-nine per cent of the survivors have perfectly clear urine. About one-half have been examined personally. In 54 per cent of these latter cases, white blood-corpuses have been microscopically demonstrated in the urine, in two-thirds of these cases, however, only a few have been observed. In one-third of the cases with pus-cells, coli-infection was observed at the same time.

|| In 74.5 per cent of the survivors there has never occurred macroscopically admixture of blood in the urine after discharge from the hospital. In 17 per cent it occurred soon after the patient's return home. In the other 8.5 per cent hæmaturia still occurs now and then.

¶ Eighty per cent of the survivors have reported themselves fully capable of work, 14.4 per cent almost so, and 5.6 per cent not capable of work.

§ Seventy-seven and eight-tenths per cent of the survivors have on post-examination been found to have increased in weight, about one-third of these by more than 10 kilogrammes, some as much as 30 to 40 kilogrammes. Nineteen and four-tenths per cent have retained their weight. Two and eight-tenths per cent have diminished in weight.

has made its appearance in other organs after the operation or if such symptoms have shown themselves, that the tuberculosis in such instances has ceased. A return to completely normal frequency has not been demanded in the case of desire to urinate but a definite and lasting considerable improvement in this respect has been demonstrated in all instances. In Israel's<sup>7</sup> material, the frequency of urination became normal after nephrectomy only in 40.9 per cent, although 63.8 per cent of the cases proved that they had healed by the disappearance of the tubercle bacilli from the urine (guinea-pig test).

One hundred and four cases fulfil these requirements, corresponding to 57.1 per cent of definite cures. The observation period has been

In 2 cases 23-25 years	In 39 cases 5-9 years
In 11 cases 15-20 years	In 16 cases 4 years
In 26 cases 10-14 years	In 10 cases 3 years

*Improved*—In 10 cases or 5.5 per cent an evident improvement of the condition has been demonstrated. The patients have become perfectly or almost perfectly capable of work, their weight has increased or remained unaltered. But the desire to urinate is still very frequent, and in a number of cases, there still remains the smarting in the urethra after urination and this several years after operation. In several cases the urine is cloudy and contains pus-cells, but no tubercle bacilli. In a couple of instances the urine is clear but slight hæmaturia occurs every now and then. The periods of observation are

In 1 case 23 years	In 1 case 9 years
In 3 cases 14 years	In 1 case 7 years
In 1 case 11 years	In 1 case 6 years
In 1 case 10 years	In 1 case 3 years

In all these instances it seems to be extremely probable that the tuberculosis of the urinary organs has ceased to develop although, at the time of the operation, the alterations in the bladder had been so pronounced that it was impossible to arrive at any *restitutio ad integrum*.

*Unimproved and Worse*—In 9 cases, or 5 per cent, the patients on post-examination have proved to be incapable of work, have frequent desire to urinate, painful urination, cloudy urine containing pus-cells and in the four cases personally examined, tubercle bacilli. In the seven instances the observation period has been less than six years, and in two instances seven and eight years, respectively.

4. *Operative Technique and Wound Healing*—The treatment of the ureter and the operation wound (drainage or primary suture) has been the subject of much discussion in the literature. Kietschmei<sup>8</sup> gives a summary of the various opinions that have come into conflict in this matter. "The many different ways of treating the ureter which have been advised is proof that the ideal method has not been obtained." The question of the primary closure or drainage of the operation wound has been discussed by, inter alia, Crabtree and Cabot.<sup>4</sup> "It is interesting to compare the end-results of the drained

## RENAL TUBERCULOSIS

wounds of this series with that of our recent cases in which the wound was closed without drainage after injecting salt solution.<sup>4</sup> In these latter cases there were 25 per cent of the wounds that remained tight, while 75 per cent developed abscesses. Abscess development was usually three to five weeks after leaving the hospital. This fact would have encouraged us to close all wounds without drainage had it not been our misfortune to follow the cases in the out-patient department and see the final results." Ekehorn<sup>5</sup> says, respecting this question "For many years back (I should think almost ten), under ordinary circumstances I close the short wound in the wall of the abdomen completely, without drainage and without tamponade. It is healed in the shortest time without any reaction at all.<sup>†</sup> The best treatment of the ureter is to allow it to drop back into the wound. One shall not be eager to remove a long portion of it. I speak from experience, for I have tried other ways, too, of treating the ureter. Suture of the ureter to the skin is an inferior—nay, a bad method."

In the present writer's material there are 135 cases with exact statements respecting the treatment of the ureter and the wound, where the patient survived for a period sufficiently lengthy to allow of an opinion being formed respecting the result of the healing. All the patients have been followed for a period of three to twenty years, with the exception of a few who died within three years. In earlier years, the drainage method was practised consistently, whether the operation wound had been infected by abscess contents from the kidney or not. During the last few years, ligation of the ureter some few centimetres down the kidney pelvis has been consistently adopted, and burning off by thermocautery, whether the ureter there was considerably thickened, hardened and tuberculized, or not, and primary suture. In cases where any infection of the wound has taken place, the wound has been drained by means of a rubber tube which has been removed after one or two days.

In earlier years, some exceptions from the rule have been made. For instance, in four cases the ureter has been sutured to the skin, and, in another four, ureterectomy has been carried out, in three of them primarily, and in one, secondarily. The table at top of page 544 is meant to show the healing results under the different conditions.

On making a comparison between the results of the different methods that have been employed, it is seen at once, and without any percentage calculation of the table, that *ligature of the ureter and primary suture, is, from the wound-healing point of view, far superior to the other methods.* Of the 64 cases, the history of which has been followed during at least three years, with the exception of a very few who died before the close of that period, all have healed *per primam* within the course of two weeks, and in only two of these cases has any secondary abscess formation arisen—in the second and third months, respectively, after operation—i. e., in striking agreement with Clabtree's and Cabot's experience,<sup>4</sup> that eventual secondary abscess formation

\* According to Mayo. Remark by the present writer.

† The majority of my primary, closed cases consists of Ekehorn's operation-material.

## MAURITZ PERSSON

	No of Cases	Definite healing in a period of														No healing yet, after a time of							
		Months							Years							Months				Years			
		½	1	2	3	4	6	9	1	1½	2	3	4		2	4	6	3	5	7	11		
Ureter sutured to the skin	4				1						1				1 <sup>1</sup>				1 <sup>1</sup>				
Ureterectomy + drainage	3											1			1 <sup>1</sup>		1 <sup>1</sup>						
Ureter ligated, dropped + drainage	64	6	12	4	5	3	15	1	6	2	4	1	2			1 <sup>1</sup>					1 <sup>2</sup>	1 <sup>2</sup>	
Ureter ligated, dropped + primary suture	64	62			1				1														

(1) Dead (2) Still living (3) Then secondary ureterectomy followed by healing in some months

after primary suture usually appears in from three to five weeks after discharge from hospital. The one case was healed definitely in another two weeks, the other in somewhat less than one year, after Röntgen treatment.

It should be noted, however, that, in the case of any infection of the operation wound by abscess contents from the kidney, complete primary closing has not been carried out. During the last few years, drainage has been done for one or two days in such instances by means of a fine rubber tube. It is these cases, together with the two clean ones, drained in the same way which occupy a special position among the drained wounds, in so far as they were healed in two weeks. The drained cases, in other respects, where the drainage material has been allowed to remain for some longer time, or has been quantitatively larger (in a relatively large number of cases, Mikulicz's drain was formerly employed), have taken a period of from one month to four years for healing, where they have really been healed. In one instance the patient still lives after having fistula for seven years, and, in another case for eleven years.

Suture of the ureter to the skin appears to be a bad method, the earliest instance of healing occurring after three months. In one instance, the wound was not healed before two years and, finally, in another case, not even after the lapse of five years.

In ureterectomy, healing was obtained in one instance three years after operation. In the others, the patients died with unhealed fistula, two and six months, respectively, after operation. In one case of drainage with very much secretion, secondary ureterectomy was carried out four months later, after which the fistula was healed during the course of some months. The relatively bad results in ureterectomy cannot be explained by the ureterectomy itself, but is probably connected with the drainage then adopted. It is a matter of course that the conditions of healing cannot very well be made worse by the removal of a large portion of the tuberculous ureter instead of allowing it to remain. But it is also clear that, in order to obtain a good wound healing, it is not necessary to carry out a total or subtotal ureterectomy.

for in none of the six cases in the table, with primary suture, had ureterectomy been undertaken, although, in a great number of instances, the ureter was thickened and rigid, evidently tuberculized, at, and also below, the place of burning off. No other measures for sterilizing that part of the ureter which was allowed to remain have been taken in the cases within this group than the thermocauterectomy of the mucous membrane after division between ligatures, after which the ureter stump has been allowed to glide back into its old position.

As a matter of fact, it is not so very wonderful if the best healing is obtained by means of primary suture, in spite of the tuberculous ureter which is allowed to remain. From a purely biological point of view, one might be able to draw a parallel between the conditions that arise on such a method of procedure and those that are found on the treatment of a tuberculous cold abscess, for instance, in a spondylitis. Such an abscess should, as we are taught by many years' experience, be treated conservatively, by, eventually repeated, puncture. If, however, it be incised and emptied then, in the most instances, we shall, of course, get the incision opening to heal quickly if primary suture be carried out immediately. If, on the other hand, this be neglected, we then obtain a fistula of long duration, difficult to heal, and with secondary infection. Another thing is the danger of secondary tuberculizing or delayed healing of the bladder which that part of the ureter which is left would cause by the continued transport of infectious material to the bladder. The number of ureterectomy cases in the present writer's material is too small to allow of any conclusive examination of the final results in comparison with those obtained by other methods. But it appears to him improbable that any considerable transport of infectious material occurs in the most cases after nephrectomy. The tendency to ulcerative decomposition is, of course, considerably much less in a tuberculous ureter than that in a tuberculous kidney. "Post-mortem examinations of the stump after nephrectomy have shown that the ureter has undergone atrophy and been converted into a hard, fibrous cord" (Kretschmer<sup>8</sup>).

In this connection, it is of interest to cite some words respecting the question touched upon above, uttered long ago by Berg<sup>1</sup>. "A good and fresh illustration of the almost diametrically opposed opinions entertained by different surgeons is the interesting discussion at the New York Surgical Society during its meeting on January 25, this year (1899). Most of the speakers on that occasion, however, were inclined to think that, as a rule, the ureter should be left untouched on the removal of the tuberculous kidney, experience having shown that Nature attends to its healing, if only the kidney be excised."

5 *Bladder Tuberculosis, its Prognostical Importance in Operated Cases* — In deciding this question it has seemed important to the present writer to neglect those cases that have been classified as immediate or operative mortality, and this because the operation trauma, as such, many times, perhaps, by some accidental circumstance, may have been able to diminish the value of the deductions that otherwise might have been drawn from the material.



In addition those cases are excluded where exact post-operative data are wanting, and also of course, those instances where it has not been possible to obtain sufficient, exact details respecting the condition of the bladder. In the total of 152 cases of nephrectomy where the patient survived six months after the operation, it has been possible to obtain the necessary data, in most of the cases by cystoscopic examination. Only in one or two instances was the extension of tuberculosis of the bladder demonstrated on autopsy, the irritability of the bladder having prevented cystoscopic examination, and in one case on section for the same reason.

Alterations of the bladder have been divided into three grades according to character and extension. *Grade I* embraces those cases where macroscopic alterations in the appearance of the mucous membrane of the bladder are absent, or is restricted to redness and swelling of, or around, one ureteral orifice, or to some few milium tubercle granules, and also those cases where the mucous membrane of the bladder displays diffuse, non-specific cystitic alterations (redness and not excessive swelling). *Grade II* includes those cases where ulcerations of tuberculous appearance exist at one ureteral orifice or in its immediate surroundings, possibly in combination with milium tubercle granules all to a relatively restricted degree. *Grade III*, finally, embraces those cases with extensive ulcerations of tuberculous appearance in the bladder, either, large, crater-shaped, or small ulcerations, spread diffusely over the whole of the mucous membrane of the bladder. The following table is intended to illustrate the end-results under various conditions caused in the different cases by the different grades and extension of the bladder tuberculosis.

Alterations of bladder	No of cases	No of deaths	Per cent of dead	Causes of death			
				Disease of remaining kidney	Pulmonary tuberculosis	Milium tuberculosis	Intestinal tuberculosis
Degree I	83	11	13.2	4	7	—	—
Degree II	61	23	37.7	11	6	5	1
Degree III	8	6	75	5	1	—	—

Although these figures are relatively small, they seem, however, to show that the degree of tuberculosis of the bladder is of no slight importance in judging of the final result. Late mortality thus shows a great rising tendency in the higher grades of alterations of the bladder, it being nearly three times greater in ulcerating alterations of medium grade (II) than where there is no, or but little, alteration of the bladder (I), while it is about five times greater in the cases with extensive ulcerations of the bladder (III).

The causes of death exhibit another interesting circumstance. In the group of no, or little, alterations of the bladder (I) it is shown that nearly twice as many patients have died of tuberculosis of the lungs as of disease of the remaining kidney. Within Group II, the condition of things is just the opposite. In Group III, the figures are so low that one does not venture

## RENAL TUBERCULOSIS

to ascribe any considerable importance to them, but, still, they point in the same direction, the increase in the number of deaths from kidney diseases, being as 5 : 1 as compared with the deaths from pulmonary causes. In other words. When there is no, or but little, alteration of the bladder, there die about 4·8 per cent of the patients in continued disease of the urinary organs, in non-extensive ulcerating alterations of the bladder, the figure rises to about 18 per cent, and in very extensive alterations of the bladder to 62·5 per cent.

In both these moments—increasing mortality and increasing relative mortality from kidney disease, we find an evident guide for our therapy, in unilateral, chronic renal tuberculosis—nephrectomy as soon as possible, before all too extensive alterations of the bladder have had time to make their appearance.

6 *Pregnancy and Delivery in Nephrectomized*—Experience seems to show that, women, otherwise healthy, who have been nephrectomized, are, in respect to pregnancy and parturition, just like fully normal women. Wildbolz<sup>14</sup> says with regard to this: “Die Einnierigkeit scheint weder auf die Schwangerschaft noch auf die Geburt und auch nicht auf die Stillfähigkeit einen schädlichen Einfluss zu haben.” Theodor<sup>15</sup>: “Einnierige Frauen überstanden eine Schwangerschaft in weitaus den meisten Fällen genau so wie Zweinnierige.”

Of the 62 nephrectomized women in the present material who were of an age for conception, 10 have, after operation, given birth either once or oftener to a total number of 17. Of these, 9 have given birth to a total of 14 fully developed living children and to one fully developed stillborn child. In last instance, both nephrectomy and, four months later, secondary ureterectomy, had been carried out during gravidity. All these 9 women are now healthy and have no traces of albuminuria, and no urinary troubles of other kinds either. (In two cases, however, transitional albuminuria has been found in connection with parturition which, in all the cases, has in other respects, been fully normal.)

One case, on the other hand, has presented a course altogether different from the other instances. It is a case where a serious degree of eclampsia developed itself during the second pregnancy after nephrectomy. And still we are probably able, with the highest degree of certainty, to exclude tuberculosis in the remaining kidney. As this case may possibly arouse a certain attention, its history is given below.

Woman, twenty-two years of age II 613/1915. Diagnosis *Tuberculosis renalis*—In 1914, gradually increasing urgency. March, 1915, slight hæmaturia. June, aching in the loins, smarting on urination and cloudy urine. Admitted July 10. Good general condition. Lower pole of right kidney palpable and tender. Urine very clouded and slightly acid. One and three-quarters per cent albumin, masses of pus-cells and red blood-corpuscles and tubercle bacilli. *Cystoscopic examination*. In right ureter, the catheter enters only one cm and no urine obtained. Left urine clear. Heller's test negative. A few white blood-corpuscles and epithelial cells. No tubercle bacilli. Operation July 21. *Nephrectomy* of the right kidney. Drainage. Anatomico-pathological diagnosis *Tuberculosis*—After operation diminishing albuminuria to only traces, after which increased

amount to one-half of one per cent, and a few granular cylinders. After wide opening of abscess in operation-wound September 28, again diminishing albuminuria. Discharge healed October 15. The patient afterwards felt better and better and married a couple of years later. Became enceinte during 1919, for the first time. In November, 1919, no albumin in urine. In January, 1920, albuminuria was discovered and the patient was admitted to the Maternity Hospital on January 23. The swellings in the hands and feet and albuminuria, epithelial cells and a few cell-cylinders, but no white blood-corpuscles in the urine. Spontaneous partus without complications. February 13. Fully developed healthy child. February 15. amount of urine, 1800 ccm, two-tenths of one per cent albumin, February 16, 1700 ccm and one-tenth of one per cent, respectively, February 18, trace of albumin. Blood-pressure 170/120, falling to 155/115 mm Hg. No other symptoms of eclampsia during stay in hospital. Discharged February 22, with trace of albumin in urine, but otherwise quite well. Afterwards subjectively healthy until close of 1923 when the patient was once more pregnant and began to be troubled with headache. Albuminuria occurred in increased degree. Admitted to Maternity Hospital January 22, 1924, when in 8th month of gravidity. A few white blood-corpuscles, but no red ones in urine. Blood-pressure 150/100 mm Hg. February 15, visual flickering, twelve per cent albumin, blood-pressure 160/110 mm Hg. Visual sharpness diminished to 1/60. Anti-eclamptic treatment according to *Shoganoff* was begun. February 16 increased visual flickering. Non-protein nitrogen in blood 35.5 per cent (according to *Folin*). Blood-pressure 200/140 mm Hg. Pronounced retinitis albuminurica. After venæsection (450 ccm) the patient felt subjectively relieved. At 7 P.M. partus provocatus (egg-membrane sticking). February 17, at 3 A.M. labor-pains began. 4 P.M. partus. Living man-child, 45 cm long. After partus, improvement, diminishing albuminuria (after one month, two per cent albumin) and blood-pressure (135/90 mm Hg). On discharge April 6, one per cent albumin and white blood-corpuscles still present in urine, considerably improved visual sharpness. Reminders after retinitis albuminurica. After examination May 4, 1925. Patient feels subjectively well. Sometimes, however, headache. Never œdema. Blood-pressure 150 mm Hg. Frequency of urination 1-2 times nightly. Urine clear acid. Hellers test positive (three per cent albumin). In sediment a very few epithelial cells, white blood-corpuscles and granular and hyaline cylinders. No red blood-corpuscles, no tubercle or other bacilli. Non-protein nitrogen 41.1 mg per cent. Eye-grounds display a certain degree of neurotic atrophy with blurred boundaries and pale color of the optic discs. Nothing pathological in macular regions.

We have thus, here a case where, about five years after nephrectomy in connection with parturition, albumin appears in the urine, simultaneously with a moderate increase in the blood-pressure, but no other symptoms of eclampsia. The urine grows free from albumin but, in connection with a second pregnancy, about four years later, albuminuria and rising blood-pressure reappear, symptoms that relatively quickly increase to fully developed eclampsia with headache, visual flickering, and greatly diminished visual sharpness. The non-protein nitrogen remains normal. Labor is induced after which the symptoms subside. The albuminuria percentage falls from 12 to 1 per cent, and the visual sharpness increases again in a considerable degree before the patient leaves the hospital, at the same time that the blood-pressure falls to about normal value. Now, one year after last parturition the patient presents 3 per cent albumin, some slight increase of blood-pressure and remainders of optic neuritis. The non-protein nitrogen-value lies at the top of the normal, and the urine sediment displays some casts, like that in chronic nephritis.

## RENAL TUBERCULOSIS

The small number of cases of pregnancy and labor after nephrectomy for renal tuberculosis contained in the writer's material, is, consequently, not calculated to negative the earlier experience that women with one healthy kidney are equal, just in the same degree as fully normal women, to the increased demands on uropoietic organs which are connected with the functions in question. But, in the above-mentioned instance with nephropathia gravidarum and eclampsia we have probably a case of *chronic glomerulonephritis* in the second stage (according to Volhard and Fahr). Possibly, the primary cause of this kidney disease lay in the formation of abscess in the operation wound, and the toxin adsorption thence. The first pregnancy has afterwards led to a deterioration in the condition of the remaining kidney (nephropathia gravidarum). During the second pregnancy, the condition has grown still worse, and has found expression as a typical eclampsia. The disease of the kidney has been of such a serious nature that a return to a normal condition has been afterwards impossible.

Thus it should seem as if a, from the beginning, very slight affection of the remaining, single kidney (the urine was even free from albumin at the beginning of the first pregnancy) under the influence of repeated gravidity could increase to such a degree that, within a few years it formed a serious threat to the health and life of the patient.

### V SUMMARY

What has been said above may be summarized as follows

We have dealt with a clinical material of 295 cases of surgical renal tuberculosis, 205 of which were subjected to operation. All the patients except 12 (8 of whom were operated on) were seen and examined again at a later date. The period of observation after discharge from hospital is, in every instance, not less than three years.

The material shows that the frequency of renal tuberculosis in men is almost twice that in women.

Hereditary tendency can be traced in 25 per cent of the cases.

Almost two-thirds of the cases are patients in the third or fourth decades of their lives.

The cases of localization to the right kidney exceed those of the left (of operated cases 109/88).

Coincident tuberculosis in other organs has, according to the records, been shown in about only half of all the cases, pulmonary tuberculosis in 22.4 per cent, genital tuberculosis (of men only), in 15.6 per cent.

Bladder irritability has been found as an initial symptom in 74 per cent of the cases, pains in the kidney region in 18.5 per cent, serious hæmaturia in 5.5 per cent. Succeeding symptoms have been bladder irritability (a further 18.1 per cent), macroscopic hæmaturia (in a further 45.2 per cent of the cases).

Incontinence has occurred in 2.7 per cent of the cases. This has been in

relatively advanced cases, but also without cystoscopically demonstrable ulceration of the bladder. Most evident in children and women.

The absence of albuminuria has been noted in 7 patients. Pyuria has never been absent. Tubercle bacilli have been demonstrated in 85.6 per cent of the cases. Palpable kidney is noted in 25 per cent, tender but not palpable in 9 per cent.

The extent and grade of the bladder tuberculosis seems to have exercised a considerable influence on the final result of the operated cases. In slight ulcerations of the bladder, the late mortality has been almost three times greater than when such have been absent (37.7 per cent and 13.2 per cent, respectively), in extensive ulcerations, the mortality has been extremely great (of 8 patients, 6 have died).

*Post-examination of Non-operated Patients*—Unilateral cases have shown a mortality (82.6 per cent) which is but little less than in the whole of the examined non-operated material (84.5 per cent) of which certainly almost half, and probably more, have been bilateral cases.

Already within five years after the clinical beginning of the disease, 63 per cent of the non-operated have died, as a rule of urogenital tuberculosis, but, in some instances, of miliary tuberculosis and pulmonary tuberculosis.

It has been impossible to demonstrate spontaneous healing of tuberculosis of the kidney in a single case. One case, surviving twenty-seven years after hospital treatment, displayed so-called autonephrectomy. Another case, after seventeen years' observation, displayed subjective perfect freedom and microscopically perfectly normal urine, the guinea-pig test, however, was positive.

*Post-examination of cases treated by nephrotomy and kidney resection* exhibit no favorable result. All the cases with perfectly certain diagnosis (6 patients) were dead when the post-examination should be made.

Bad results are also shown after *nephrectomy in bilateral cases*. All the 8 patients died within two years after operation.

The total *operative mortality in nephrectomy for unilateral renal tuberculosis* amounts to 7.3 per cent. The corresponding figure for that half of the material latest operated upon—during the last five years—amounts to only 4.7 per cent. The operative mortality for men is more than twice that for women (9.5 and 4 per cent, respectively). The cause of death in two of the earliest cases in the material was uræmia, a complication which afterwards has not occurred for the last twenty years, although actual function tests from the different kidneys have never been made during this period.

The late mortality amounts to 24.7 per cent. Only 11.1 per cent of the late mortality has occurred during the first year after operation, 46.6 per cent within the first three years. Late mortality is considerably greater in the case of men than in women (28.4 per cent and 19.2 per cent, respectively).

The total mortality is, consequently, almost twice as great as in the case of men as in that of women (40.3 and 23.3 per cent, respectively).

Forty-four and four-tenths per cent of the late mortality deaths were caused by disease—tuberculosis in every case but one—of the remaining

## RENAL TUBERCULOSIS

kidney In 35.5 per cent the cause of death has been pulmonary tuberculosis, in 13.3 per cent military tuberculosis

*Fifty-seven and one-tenth per cent of all the operated cases are, on post-examination, healthy, another 5.5 per cent exhibit an evident improvement* Of these latter, one-half have lived more than ten years after the operation Only in one case of one-third of the 57.1 per cent healthy cases has the micturition frequency become completely normal, however

Five per cent of all the operated patients are worse, but still alive Four of these 9 patients have, on personal examination, shown tubercle bacilli in the urine

The best possible operation wound healing appears to have been secured by ligation of the ureter and burning it off by thermocautery below the kidney pelvis, and allowing the stump to drop back, and, finally, primary suture of the wound Abscess formation has occurred in only 2 of 64 cases treated in this way, all of which were followed for a long time after operation Equally good healing has been obtained, however, in 4 cases where, after infection of the wound from the abscess contents, a little draining tube has been inserted for the next day or two after the operation

Women, *otherwise healthy*, who have been nephrectomized for renal tuberculosis, can go through pregnancy and parturition just as well as normal women

But, on the other hand, if the remaining kidney be affected by a chronic nephritis, pregnancy can lead to exacerbation of the disease

### REFERENCES

- <sup>1</sup> Berg On the Question of the Treatment of the Ureter in Operations for Renal Tuberculosis Annual Report from the Serafimer Hospital, Stockholm, 1899
- <sup>2</sup> Braasch Clinical Observations from 203 Patients Operated on for Renal Tuberculosis Jour A M A, vol lvm, 1912
- <sup>3</sup> *Idem* Surgical Renal Tuberculosis The Am J of the Med Sci, vol clx, 1920
- <sup>4</sup> Crabtree and Cabot The End-results of Seventy Cases of Renal Tuberculosis Treated by Nephrectomy Surg Gynec & Obst, vol xxi, 1915
- <sup>5</sup> Ekehorn On the Diagnostics and Treatment of Tuberculosis of the Kidney and Urinary Organs Hygiea Stockholm, 1922,
- <sup>6</sup> Hornstein Graviditat nach Nephrektomie, ihre Einwirkung auf die zuruckge bliebene Niere Ztschr f gynak Urologie, Bd ii, 1910
- <sup>7</sup> Israel Die Endresultate der Nephrektomien bei Nierentuberkulose Fol Urol, Bd vi 1911
- <sup>8</sup> Kretschmer The Treatment of the Fatty Capsule and the Ureter in Nephrectomy for Renal Tuberculosis Surg, Gynec & Obst, vol xxiii, 1916
- <sup>9</sup> Kummell Chirurgie der Nierentuberkulose Archiv f Klin Chir, Bd cxxvi, 1923
- <sup>10</sup> Lower and Shupe End-results of Nephrectomy for Renal Tuberculosis Surg, Gynec & Obst, vol xxv, 1917
- <sup>11</sup> Rafin Mode de debut de la tuberculose renale Journal d'Urologie, Par, vol i, 1912
- <sup>12</sup> Roysing The Diagnosis of Tuberculosis of the Kidney in Very Early and Very Advanced Cases Jour A M A, vol lxx, 1912
- <sup>13</sup> Theodor Über Nephrektomie und Schwangerschaft Ztschr f Urolog Chir, vol vii, 1921
- <sup>14</sup> Wildbolz Chirurgie der Nierentuberkulose Stuttgart, 1913
- <sup>15</sup> *Idem* Über die Dauererfolge der Nephrektomie wegen Nierentuberkulose Ztschr f urol Chirurgie vol viii 1921

# MALIGNANT TUMORS OF THE TESTICLE

A PATHOLOGICAL STUDY

BY FRANK HINMAN, M D

WITH

THOMAS E GIBSON, M D AND ADOLPH A KUTZMANN, M D

OF SAN FRANCISCO, CAL

OF LOS ANGELES, CAL

FROM THE DEPARTMENT OF UROLOGY AND DEPARTMENT OF SURGICAL PATHOLOGY, UNIVERSITY OF CALIFORNIA  
SAN FRANCISCO

*Introduction*—Several earlier publications by the authors on tumors of the testicle have been devoted chiefly to their clinical aspect, with particular reference to treatment. The present paper is concerned with their pathology and with the purpose of presenting further evidence to attempt to solve the widely disputed problems as to their histogenesis. The conclusions reached are based on a detailed study of 22 cases of testicular tumors.

*Historical Note*—Reference to the literature cannot help but impress one with the confusion and disparity of opinion extant respecting the pathology of testicular tumors. No satisfactory classification based on firmly established histogenetic facts has hitherto been presented and received general acceptance. The variety of tumors reported in the voluminous literature on testicular neoplasms runs the entire gamut of our oncological glossary, so that attempts in the past to bring some semblance of order out of this chaotic condition have been beset with difficulties and any further effort to throw light on this phase of the subject is of importance.

A brief historical resume of the subject is essential as an approach to a clear understanding of the present status of their pathology. As early as 1696, St. Donat described a complex tumor of the testicle in which he recognized the bones of a rudimentary skull and two pigmented depressions which he interpreted as the embryonic eyes of a parasitic fœtus (Ewing). In 1845, Sir Astley Cooper wrote an elaborate treatise on the gross characteristics of testicular tumors. Johnson, in 1856, is credited as being the first to recognize the tridermal constitution of certain tumors of the testicle. In 1887, Langhans and Kocher ventured the opinion that the group of teratomata embraced a large proportion of all tumors of the testicle, and laid the basis for an accurate classification according to microscopic structure. It remained for Wilms, however, in 1896 to demonstrate conclusively the fact that most tumors of the testicle are teratoid in nature. In 1911, Ewing published the most important and authoritative contribution to the pathology of testicular tumors. From a painstaking review of the literature and the analysis of a series of 19 cases, he came to the conclusion that practically all tumors of the testicle are teratomatous in origin, or fundamentally tridermal in constitution,

## MALIGNANT TUMORS OF THE TESTICLE

although in a certain percentage of cases one type of tissue (a monodeimal derivative) may have overgrown the other constituents and given rise to the appearance of a unicellular or homologous type of tumor

He thus challenged the contention of Chevassu, whose exhaustive treatise had been published in 1906, and that of Debainardi appearing the same year. Chevassu had demonstrated that a large proportion (about one-half) of tumors of the testicle were of a solid medullary, large celled type, the cells being identical in morphology and staining reactions with certain cells of the spermatogenic cycle, namely, the spermatocytes (Fig 7). These tumors, presumably derived from cells of the seminal tubules, he called "seminomes". Schultz and Eisendrath (1921), describing the same type of tumor applied the term "spermatocytoma". Earlier investigators including Tizzoni (1876), Birch-Hirschfeld (1877), Talavera (1879), and Langhans (1887), studied this type of tumor and believed they could trace the gradual transition of the seminal epithelium into neoplastic formations. Chevassu, although a champion of the spermatogenic origin of this type of growth, did not accept this earlier work since he himself was unable to actually demonstrate this transition.

Although the classification of testicular tumors has become greatly simplified through the classical investigations of Wilms, Ewing and others, there have arisen two opposing schools, one maintaining that, "for practical purposes there exists only one tumor of the testicle, namely, a teratoma" (Ewing, O'Crowley and Martland, Wilms, Pick, Ribbert, etc.), the other, that in addition to the obviously teratomatous group of tumors there exists a large proportion of testicular neoplasms which are purely homologous or single-cell tumors (seminomes) derived from the cells of the spermatic tubules (Chevassu, Frank, Schultz and Eisendrath, Sakaguchi, Vecchi, Geist and Thalheimer, Hardoun and Patel, etc.)

It is now possible, we believe, to effect a reconciliation of these opposing views with the evidence at hand.

*Analysis of Personal Cases and Discussion*—The detailed reports of the 22 cases in our series are appended. Analysis of this series shows that 10 are diagnosed teratomata or mixed tumors (heterologous tumors) and 12 as "seminomes" or single-celled tumors (homologous tumors). The two types occur with about equal frequency, coinciding with the statistics of Chevassu, who in a series of 120 testicular neoplasms found that 59 were seminomes and 61 were teratomata and with the report on the pathological material of 22 cases of the Johns Hopkins Hospital personally examined by one of us (Hinman, 1914), of which 12 were single-celled and 10 mixed tumors. There were no sarcomata. In only one mixed tumor of our present series was there any tissue that suggested sarcoma, but even in this case the malignancy of the growth was due to epithelial proliferation. This point is emphasized because the literature abounds with reports of "sarcoma testis". Indeed, this seems even at present to constitute the most frequent diagnosis



in cases reported in spite of the authoritative contributions of Wilms, Ewing, Chevassu, Schultz and Eisendrath, and others who have firmly established the fact that sarcoma of the testicle, occurring either as a pure homologous tumor or as a part of a heterologous tumor, is exceedingly rare. Undoubtedly, the term "sarcoma" is applied in the literature in most instances to the seminoma type of tumor because of the histological resemblance to lymphosarcoma or large round-cell sarcoma.

All of our 22 cases of testicular tumor were definitely malignant supporting the contention now well established, that practically all tumors of the testicle are malignant. The adult teratoid tumor or dermoid, such as was described by St. Donat is of great rarity, notwithstanding the fact that many so-called benign mixed tumors are reported. Respecting other types of benign tumors, Ewing accepts only two cases reported by Chevassu and Pick as authentic. These were adenomata of the seminal tubules, and are quite different from the seminoma which is considered as arising from the seminal tubules. Benign interstitial cell tumors have also been reported, but are evidently examples of hyperplasia rather than neoplasia (Ewing).

Other tumors which may at times be confused with testicular tumors are those arising in the epididymis, spermatic cord or testicular tunics. These are of rare occurrence as compared with testicular tumors, and differ from them in being nearly always homologous, and quite as often benign as malignant. The malignant forms are usually sarcomatous. We have had but three extra-testicular tumors primary in these structures—a fibroma of the spermatic cord, an adenocarcinoma of the epididymis, and a fibroma durum of the tunica vaginalis. A complete review of the subject of tumors of the epididymis, spermatic cord and testicular tunics was published (Hinman and Gibson) in 1924.

Thus the final analysis shows that we have to consider but two types of testicular tumor, both of which are malignant the teratoma or mixed tumor and the seminoma or unicellular type of tumor. The pathology of testicular tumors would be further simplified if we could accept Ewing's dictum that the seminoma is also of teratomatous origin and represents merely a one-sided (monodermal) development of a tumor primarily tridermal in constitution. Ewing maintains that this hypothesis is subject to proof and states that in several instances he has been able to demonstrate other types of tissue in the seminomata as well as seminomatous tissue in teratomata. His beliefs, however, have been largely ignored or discredited, as shown by the fact that several observers have since reported series of the seminoma type in which careful study failed to reveal mixed tissues (Schultz and Eisendrath) and conversely search of characteristic mixed tumors failed to reveal any areas of the seminoma type of cells. Although we have not subjected our own specimens to serial section we have been impressed with the uniformity of seminomata as distinguished from mixed tumors and were likewise skeptical of Ewing's beliefs until studying specimen No. 2356 in our series. We have always subjected our seminomata to careful histologic study in an effort to

## MALIGNANT TUMORS OF THE TESTICLE

corroborate Ewing's theory, and were finally able to do so with this single specimen in which mixed tissues of various types were found abundantly associated with typical seminomatous tissue (Figs 4 and 5) *The term "seminome" or "spermatocytoma" must therefore be regarded as a misnomer, and the contention of Chevassu is disproved in favor of Ewing's theory*

To what adult tissue the cells forming this peculiar tumor are related is impossible to say any more than it is possible to relate certain other types of tissue occurring in teratomata, but Ewing regards it as an epithelial type and calls them "embryonal carcinomata" of teratomatous origin. Obviously, the overgrowth of this type of tissue so as to completely shut out the other teratomatous components must either occur very early in the life of the tumor, or else be due to an unusual degree of malignancy with rapid cellular proliferation. We favor the former explanation, since clinical experience has taught us that this type of tumor is apparently no more malignant than other types.

In general, the malignant elements in mixed tumors of the testicle are almost uniformly epithelial in type, and therefore carcinomatous in nature. It would therefore seem logical to regard the so-called "seminome" as a carcinomatous proliferation in a tumor primarily teratomatous in origin. The peculiar lymphoid stroma, which forms a more or less constant feature of this type of growth, is not explained on an inflammatory basis, but further than that, no explanation of its significance has been offered.

The carcinomatous elements in teratomata are generally amenable to classification into one or more of three groups, (a) trophoblastic (chorioepithelioma), (b) hypoblastic (the usual adenomatous tumor), and (c) epiblastic (solid alveoli of basal-cell type or tumors of neurocytoma type). All three of these types are denoted as "embryonal carcinoma" by Schultz and Eisendrath. Ewing limits the term "embryonal carcinoma" to the seminome type of tumor. The first type is comparatively rare. Doctor Cooke, formerly of the Department of Pathology of the University of California Medical School, was able to collect but 47 cases. It is of interest to note that only about one-half of the choriomata reported revealed other types of tissue. The second type (hypoblastic), exclusive of the so-called "seminome," comprises the vast majority of teratomata, and is figured in the accompanying histologic illustrations of mixed tumors.

Summing up briefly, it can now be taken as definitely established that practically all tumors of the testicle are teratomatous in origin, and furthermore that practically all testicular tumors exhibit some type of carcinomatous degeneration of which the so-called "seminome" is but a modification. Furthermore, pathologically and to some extent clinically, the "seminome" presents certain vital differences which set them apart from the other teratomata. Clinically, it is now fairly well established that the "seminome" is relatively susceptible to radiotherapy, whereas other types of teratoma are less favorably influenced. There is a different age incidence, the majority of teratomata occurring in the third decade and seminomata in the fourth decade.

Pathologically, the differences are well illustrated in the gross and microscopic characteristics shown in accompanying figures. The "seminoma" presents grossly (unless altered by hemorrhage and necrosis) a uniform solid picture (Fig. 2) and microscopically a solid medullary type of growth (Figs. 3, 6 and 7) in which other types of tissue are rarely found. Other teratomata present grossly a characteristically complex cystic picture (Fig. 1), and histologically an equally complex picture (Figs. 9, 10, 11), in which one sees various types of carcinomatous proliferation, cystic spaces lined by different types of epithelium, islands of squamous cells, islands of cartilage, etc., all supported upon a more or less abundant connective-tissue stroma.

On the basis of these facts, it should be possible now to establish a scientific and accurate classification of testicular tumors which could receive general acceptance. The difficulty lies in creating a suitable terminology for the type of tumor hitherto misnamed "seminoma" or "spermatocytoma." Shall we retain the term "embryonal carcinoma" applied to it by Ewing or the descriptive term "seminoma", or shall we add to the existing confusion by introducing a new terminology? The term embryonal carcinoma is neither appropriate nor distinctive since practically all teratomata exhibit epithelial degeneration which could rightly be termed "embryonal carcinoma." No distinctive new term suggests itself, with the remaining alternative to continue calling this distinctive group of tumors "seminomata," bearing in mind that these tumors are teratomatous in origin and that this term is merely descriptive, denoting a resemblance to, and not an origin from, the seminal cells or spermatocytes. Until a better term is substituted, it will serve a useful clinical purpose in differentiating between the two great groups of testicular tumors of a common origin. In our present state of knowledge, it is impossible to say whether the seminoma is trophoblastic, hypoblastic, or epiblastic in nature, since, as Ewing has said, 'It is a highly characteristic structure which is duplicated by no other structure.' It seemingly duplicates, or at least resembles, the epithelial cells of the spermatid tubules, the spermatocytes, so that perhaps it falls into a separate category, namely, mesoblastic, since the gonads are of mesoblastic derivation.

To be more explicit, let us follow the development of such a tumor through from the beginning. Teratomata are characterized by their potentiality to reproduce all the structures in the human body. They are middermal in constitution, all the primitive germ layers being present. It is logical to assume, therefore, that a teratoma may reproduce the cellular characteristics of the adult testicle, just as it may form bone, cartilage, glandular tissue, etc. In other words, a teratoma is capable of reproducing seminal epithelium which may undergo neoplastic transformation just as other epithelial structures in a teratoma may do, and then proliferate to such an extent as to completely overgrow other types of tissue originally present. Obviously, from our present knowledge of the pathology of teratoma testis, the seminoma cannot be classed with either trophoblastic, hypoblastic, or epiblastic types of teratoma, so that the only remaining alternative may be mesoblastic. Hence it

## MALIGNANT TUMORS OF THE TESTICLE

is possible that the "seminome" represents an epithelial overgrowth of mesoblastic origin in a teratoma. Since the gonad with its seminal epithelium is of mesoblastic origin, the seminome may well be a carcinoma of seminal epithelium on a teratomatous basis, but this theory is of course purely conjectural.

The following classification of testicular tumors, a modification of Schultz and Eisendrath, is submitted:

### I *Homologous Tumors*

#### A *Benign*

##### 1 *Epithelial*

(a) Adenoma of the seminal tubules (the tumors of Chevassu and of Pick are accepted by Ewing)

##### 2 *Mesoblastic*

(a) Interstitial cell tumors (probably not true tumors, but merely hyperplasia (Ewing))

#### B *Malignant* (Do not occur)

### II *Heterologous Tumors (Teratomata or Mixed Tumors)*

#### A *Benign*

1 Adult teratoid tumors or cystic dermoids (Exceedingly rare)

#### B *Malignant* (Embraces practically all tumors of the testicle)

1 *Embryonal Carcinoma* (Heterologous tissues may be present or may have been overgrown)

(a) Trophoblastic (chorioepithelioma) (Rare)

(b) Hypoblastic (the usual adenomatous tumor)

(c) Epiblastic (solid alveoli of basal-cell type or tumors of neurocytoma type)

(d) Mesoblastic (?) (so-called "seminome") (They constitute about one-half of the malignant tumors occurring in the testicle)

2 *Sarcomatous Mixed Tumor* (True sarcoma occurring in a teratoma is very rare. Probably the few authentic cases of sarcoma reported as homologous tumors represent one-sided developments of teratomata)

*The Site of Origin of Teratoma Testis*—The ultimate solution of the pathogenesis of testicular tumors is identified with that of teratomata in general. The many theories of origin of teratomata are still unproved and it would be useless to review them here, since we have nothing new to add. We are satisfied for the moment with having demonstrated that practically all tumors of the testicle, including the seminome, are teratomatous in origin. The precise point at which tumors of the testicle first begin is still debatable. Most tumors examined have been so far advanced that most or all of the testicle was replaced. In some, however, a narrow margin of testicular tissue remains at a point opposite the attachment of the epididymis. It would seem, therefore, that the tumor arose in the region of the rete testis or in the region immediately between the testis and epididymis, possibly from some vestigial mesonephric structure. An unusual instance of early tumor is shown in Fig. 3, in which the tumor occupies the site of the epididymis which is compressed into a thin capsule. Only a few small foci of tumor cells are found in the testis.

These facts lend support to Ewing's theory, in which he believes that

teratoma testis arises from totipotent sex cells in the rete, and from there invade the testis proper. In the unusual instance just cited it is conceivable that the tumor, following the path of least resistance, chose to grow toward the epididymis rather than into the fibrous, atrophic testicle.

#### CASE REPORTS

##### *I Teratomata*

CASE I—C. A. L., age twenty-four years. History of injury to the left testicle one and one-half years ago followed by tenderness and swelling. Tenderness disappeared,

but testicle remained large. Wassermann at this time was positive, received anti-luetic treatment, but testicle continued to enlarge. Loss of ten pounds in last one and one-half years. A radical operation for teratoma testis was performed; the vas and all pre-aortic lymph-glands were resected. Much bleeding was encountered during the course of operation. The mass of glands adherent about the inferior mesenteric artery necessitated resecting the artery. The patient died

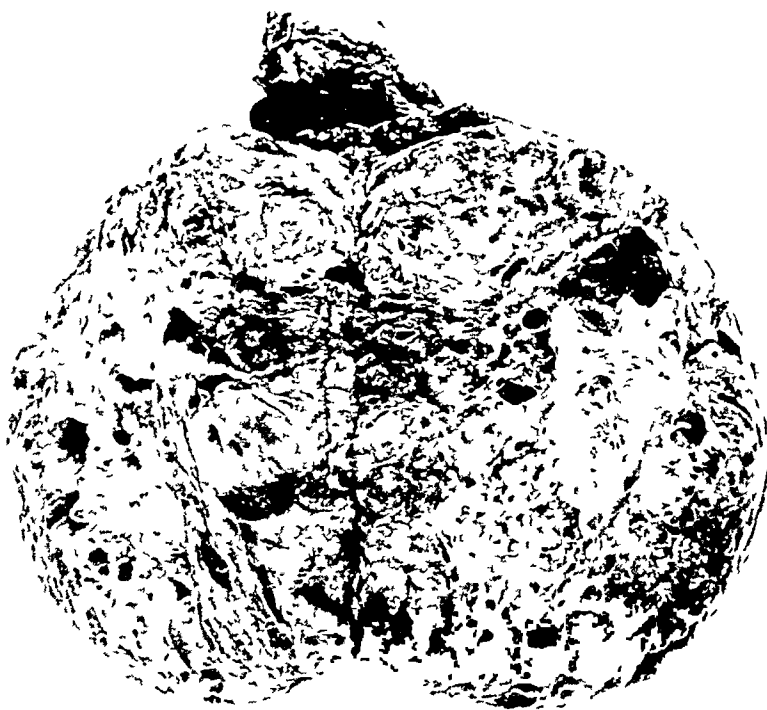


FIG. 1.—Photograph of mixed cell type of testicular tumor, a teratoma, in sagittal section. No normal testicular tissue is seen and there are multiple dissimilar areas and cystic spaces characteristic of different types of tissues, such as cartilage, gland, etc. Note the contrast between this type of tumor and the uniform picture of the single cell type of tumor illustrated in Fig. 2. The size of the tumor was 9 x 10 cm.

suddenly while joking with a friend the following day of what clinically looked like embolism. Autopsy not permitted.

*Gross Pathology*—The tunica and epididymis are involved in a dense mass of adhesions. Upon section, the tunica everywhere appears infiltrated with tumor. The interior is filled by an irregular fungating growth resembling a mixed tumor.

*Microscopic Pathology*—Examination shows a variety of pictures. In some places there is cartilage, normal in character. The background in some areas is composed of a fairly cellular fibrous tissue, showing oedema. Coursing through it are numerous epithelial structures, at times lined by a single layer of epithelium of low cuboidal form. In other regions duct-like structures are lined by high columnar epithelium, one layer thick, in still other regions are more duct-like structures and papillomatous masses consisting of epithelium many layers in thickness. It is especially among these cells that mitoses are observed. In the stroma associated with such areas there is some lymphocytic infiltration and larger irregular necrotic areas. In the necrotic areas one not infrequently sees evidence of old hemorrhage. The invasive character of the growing epithelium in many

## MALIGNANT TUMORS OF THE TESTICLE

areas is quite striking and definite invasion of endothelial-lined cavities is seen. There are also noted epithelial structures lined by stratified epithelium, the central cells of which are undergoing keratinization.

Several glands removed at radical operation show cancerous invasion, which for the most part forms structures with a somewhat papillomatous appearance, the superficial cells of which form a somewhat irregular layer, while the small cells have an oedematous reticulated appearance. Necrosis of considerable extent occurs together with spaces corresponding to cholesterol crystals, about some of which is slight giant-cell formation. There is also pigmentation of old hemorrhage. In other areas the invading epithelium is of the more deeply stained type, although there are suggestions of transitions between the types.

*Diagnosis*—Teratoma testis with glandular metastases

CASE II—S C, No 564

*Microscopic Pathology*—Examination shows large connective-tissue stroma which in itself exhibits a variety of pictures, from myxomatous degeneration to dense cellular sarcomatous ap-



FIG 2—Photograph of a single cell type of testicular tumor, a seminoma. At the inner edge of the left half of the specimen is seen a small compressed remnant of testicular tissue. This type of tumor is characterized by its uniformity and homogeneity in the gross and microscopic picture although occasionally there may be areas of necrosis. The tumor measured 5 x 7.5 cm.

pearing areas. Numerous cysts are seen showing many variations, some being lined by columnar epithelium, while others have cuboidal epithelium. Many contain an eosinophilic material which appears as colloid. Other spaces are filled with small darkly staining cells in alveolar formation. Still others are lined by typical cornifying squamous epithelium in which the keratohyalin granules may be seen. In some small areas are definite adenocarcinomatous cell groups infiltrating the connective-tissue matrix. Occasional cystic spaces may be seen to be filled with inflammatory exudate containing polymorphonuclear cells. Groups of lymphocytes appear in various areas of the stroma, giving the appearance of minute abscess formation.

*Diagnosis*—Teratoma testis

CASE III—S P, No 1137 *Microscopic Pathology*—Examination of sections shows a dense connective-tissue matrix which is replaced to more than one-half in extent by areas of epithelial proliferation. The epithelial growth closely resembles a papillary cystadenoma, malignant in character. The papillary type of growth loses its identity in some areas forming a more medullary type of growth. In the centre of some of these large areas is a moderate amount of inflammatory reaction as indicated by the presence of polymorphonuclear neutrophils, also in some of those areas may be found extensive areas of necrosis. The carcinomatous areas are well circumscribed, there being no diffuse infiltration through the connective-tissue matrix.

The individual epithelial cells vary in morphology, but are uniformly small and bear

no resemblance to the spermatoblast type of cell. Their nuclei are round or oval and seem devoid of cytoplasm. The chromatin is irregularly distributed. The cell nuclei contain one or more nucleoli and frequent mitoses are seen. No other type of epithelial growth can be seen in the sections examined. The connective-tissue matrix is fairly uniform in structure and does not appear sarcomatous in any area. On one margin of a section examined is seen atrophic testicular tissue and on the side opposite, tubules of the epididymis.

*Diagnosis*—Teratoma testis with adenocarcinomatous tissue

CASE IV—R. D., No. 1450. *Microscopic Pathology*—Examination shows a variety of tissues. There is a connective-tissue matrix which shows ramifications throughout of



FIG. 3—A. Photograph of sagittal section of an undescended testicle removed at operation from a patient of twenty-seven years. T. Malignant tumor (seminoma). E. epididymis, B. atrophic testicle. A. margin of normal glandular tissue, D. area of necrosis and hyalinization. The solidity of the tumor mass and its circumscribed margin are evident. There is a definite line of demarcation between tumor and testicle and the compressed shell of epididymis can be peeled off the tumor everywhere except at the upper pole to which it is intimately attached. A few small foci of tumor cells are present in the testis at the points marked C. The position of this tumor may indicate the possible site of origin of testicular tumors in the rete or some embryonic vestige between the testis proper and the epididymis. This tumor has apparently followed the line of least resistance growing toward the epididymis rather than the fibrotic testicle. B. Photomicrograph (high power) showing typical area from tumor T. Note the solid unicellular type of tissue with a lymphoid stroma characteristic of the seminoma. The cells are somewhat exceptional showing more cytoplasm than usual.

epithelial cells growing in wild disorder, but tending on the whole to assume a rough pattern of adenocarcinoma. This pattern is lost in places, the cells tending to grow in solid sheets. The epithelial cells appear large, with abundant eosinophilic cytoplasm and having indistinct borders. The nuclei varying markedly in morphology and staining properties, differ in this respect from the large round nuclei of the seminoma cells with their uniform fine stippling. Areas of necrosis are present. The growth infiltrates diffusely in areas, giving the tissue an almost scirrhus appearance. In other areas are cystic spaces lined by various types of epithelium varying from the flat to narrow columnar type.

*Diagnosis*—Teratoma testis

CASE V—B. W., No. 1567. Age thirty-seven. Two months ago patient noticed that his right testis was beginning to swell. This had always been slightly larger than the left. Increase in size came on suddenly and without any evident cause. Orchidectomy with removal of inguinal glands was performed. The patient was seen in the clinic on several occasions during the following few weeks. He continued to lose weight and the abdominal masses gradually enlarged. Death occurred two months after castration. Autopsy showed enormous metastatic tumor masses in the pre-aortic retroperitoneal space and nodules in the liver and lungs with the same histologic picture as the testicular tumor.

## MALIGNANT TUMORS OF THE TESTICLE

*Pathological Report*—Malignant mixed tumor of the testicle with retroperitoneal metastases \*

*Gross Pathology*—Specimen consists of large ovoid mass measuring 6.5 x 11 cm. The vas is thickened and nodular. The epididymis is replaced by a large nodular mass. Upon section the tumor grinds under the knife, suggesting cartilage. An extremely variegated surface is presented. Numerous cystic areas are seen, partially filled with grumous, mucoid or hemorrhagic appearing material. The intervening areas present a cellular appearance with small islands of cartilage in relief. Other areas show much fibrous tissue and numerous areas of necrosis more or less hemorrhagic in character.

*Microscopic Pathology*—There are numerous areas which show epithelial-like cells with comparatively little stroma. These are often arranged around blood-vessels in the form of islands, separated by necrotic material. Many mitoses are seen. There are other areas which show groups of cells which are rather large with small, round nuclei and stippled cytoplasm. These appear very much like foetal fat cells. There is an abundance of fibrous tissue throughout.

*Diagnosis*—Mixed tumor of testicle, malignant

CASE VI—E. L., No. 2021. Age thirty-three years. Patient had noticed that his right testicle was larger and harder for the last two and one-half years. Neisserian infection twice—left epididymitis with first attack and balanitis, followed by bilateral buboes. Three Wassermanns were negative and two salvarsans caused no change in size of tumor.

A radical operation for teratoma testis with resection of the pre-aortic glands was performed. There was uneventful convalescence until the twelfth day, when the patient complained of severe pain down the left leg (operation on right side). There was marked tenderness over the femoral vessels and distention of the superficial veins with considerable oedema. Complete recovery with discharge at the end of three weeks. The patient died nine months post-operative.\*

*Gross Pathology*—Specimen consists of a mass closely resembling normal testis except that it is slightly larger than normal, measuring 2.5 cm x 4 cm. The vas and epididymis appear normal. The tunica is smooth and presents no nodules or adhesions. The mass is very firm in contrast to the normal testis. Upon section through the long axis, the knife cuts with difficulty and grinds on substance which is presumably cartilage. The cut-surface presents a variegated picture characteristic of the malignant mixed tumor of the testis. There are numerous cystic cavities of varying size, some filled with grumous material, others with mucoid substance. The solid portions of the growth vary from grayish-white to yellow in color, interrupted here and there by areas of hemorrhagic necrosis. The tunica albuginea is thin and the tumor appears everywhere confined within its limits. No normal appearing testicular tissue is evident anywhere in the specimen.

*Microscopic Pathology*—Sections of the testicle show a mixed picture. There are two distinct conditions shown, namely new growth and massive degeneration. The new growth shows in some areas tumor cells rather loosely grouped together with moderate intercellular connective tissue. In other areas there is an attempt at gland structure, in others there is a tendency to a papillomatous arrangement. The blood supply is poor and small areas of degeneration are seen everywhere. The vessels have very thin walls and in some areas where degeneration is rather marked, the perithelial arrangement is present. The predominating cell is large, irregular in shape, but with a tendency toward being oval, with nucleus occupying large part of cell and varying according to the shape of the cell. Atypical mitoses are abundant. There is one area where from two to six cells are grouped together and surrounded by a thin sheath of connective tissue suggesting nerve structure.

*Diagnosis*—Teratoma testis

\*Himm in Frank. Radical Operation for Teratoma Testis, with Report of Five Cases. *Surp., Gyn. and Obs.*, 1910 vol. XXXIII p. 495.



CASE VII—R B W No 2189 Age thirty years History of trauma to left testicle seven years ago Noticed soon after a small lump on the left testicle which gradually grew until within a year it was a mass twice the size of a normal testicle Unchanged until nine months ago, since which time it has been increasing in size and becoming more painful

A radical operation was performed for teratoma testis with complete resection of lymphatic areas along the iliac artery and abdominal aorta There was an uneventful recovery Pathological examination showed an early metastasis to one retroperitoneal lymph-gland Patient living and well, five years post-operative†

*Gross Pathology*—Specimen consists of ovoid mass, roughly egg-shaped measuring 6 x 8 cm The tunica albuginea is everywhere smooth and intact The epididymis and vas appear normal in size and consistency The digital fossa is well preserved and there is no evidence of adhesions The mass is very firm on pressure Upon section through the long axis is seen a fairly uniform, smooth, grayish-white structure darkened here and there by hemorrhagic extravasations The cut surface appears very cellular and does not present cystic spaces and irregularities There is no evidence of normal testicle, the growth filling the entire tunica albuginea

*Microscopic Pathology*—Sections through the tumor show a great variety of pictures—predominating is a diffuse arrangement of carcinoma-like cells and adenomatous arrangement of epithelial cells The cells lining the spaces are for the most part of the columnar variety, a good many resemble perithelial arrangement There are many alveoli resembling well-developed thyroid There is an abundance of myxomatous tissue in places showing a tendency toward a papillomatous arrangement Areas are seen in which small round, nucleated heavy stained cells are densely packed together, suggesting lymphoid tissue No cartilage is seen, no squamous epithelium in full stage of development The picture is of a mixed tumor type with a preponderance of epithelial elements

*Diagnosis*—Teratoma testis

CASE VIII—W C, No 2356 Age thirty-six years Mumps several years ago with right orchitis resulting in atrophy Two Neisser infections and chancre Had two and one-half years' treatment for lues Four months ago while at work patient slipped and strained himself The right testicle became swollen and tender Under intense anti-luetic treatment, the tumor increased in size A radical operation was performed for teratoma testis with resection of pre-aortic glands Pathological examination showed extensive metastases to the lymph-glands Patient discharged one month post-operative, lost track of since two months after operation†

*Gross Pathology*—Specimen consists of a mass, shaped like a testicle, measuring 8 cm. in greatest diameter The cut surface shows interlacing bands of connective tissue, between which are areas of degeneration, areas of quite cellular tissue resembling cartilage in many places cystic cavities, and various other strange pictures characteristic of malignant mixed tumor

Fatty retroperitoneal tissue removed at the radical operation containing the regional lymph-nodes of the testicle are also present One of these glands is much enlarged being 3 cm in longest diameter, and it is also quite hard

*Microscopic Pathology*—Sections from the testicle show a varied picture There are spaces lined by columnar epithelium in several layers Some of these spaces are very large and show a great deal of desquamation into the lumen with regeneration of elements and many mitotic figures are seen among the active cells There are other spaces lined by single layers of cuboidal cells, also showing mitoses, the lumen is filled with faintly staining pink substance remotely suggesting colloid There are areas of cartilage of the hyaline variety Some sections show enormous islands of cartilage, and also true bone Large fields of loose connective tissue and, in addition, compact masses

† Hinman Frank Radical Operation for Teratoma Testis, with Report of Five Cases Surg Gyn and Obs 1919 vol xxxviii p 495

## MALIGNANT TUMORS OF THE TESTICLE

of distinctly connective-tissue cells with deeply staining oval or elongated nuclei showing mitosis, are present

At least two distinct types of epithelioid proliferation are seen growing diffusely through the stroma in various areas. One, which is very abundant, consists of cells with large oval or round nuclei, showing fine stippling. *These cells are supported on a*

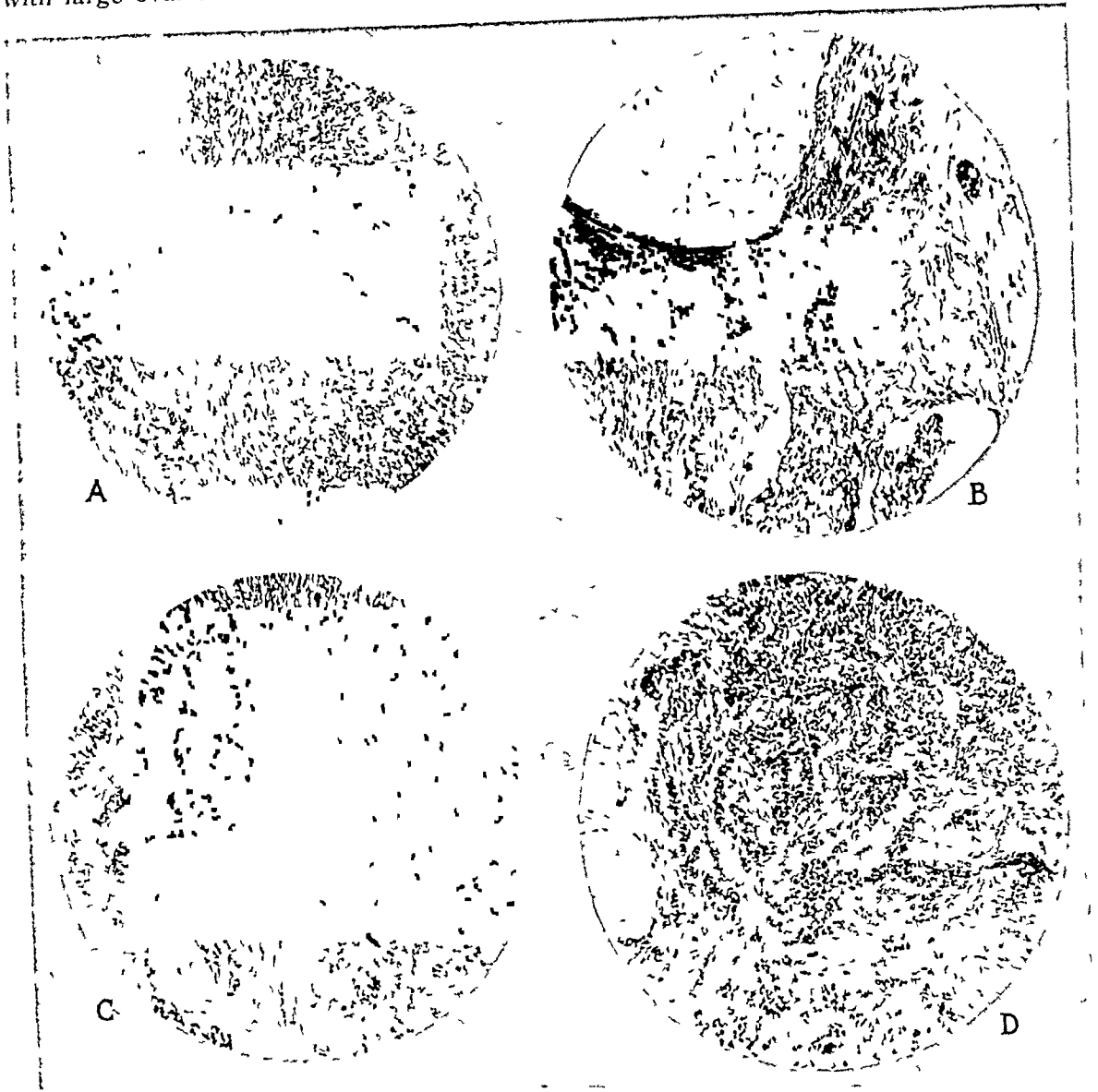


FIG. 4.—Photomicrographs (low power) of characteristic areas from specimen No. 2356. All four photomicrographs show abundant seminoma tissue occurring with other types of tissue. This is the same type of cell which has been referred to as embryonal carcinoma and spermatocytoma. A. On the left are two distinct islands of cartilage. On the right is a typical field of the seminoma type of cell, while in the middle lies a dense connective-tissue stroma. B. At the upper margin is a well circumscribed island of cartilage, below this may be seen a loose connective-tissue stroma into which projects a tongue of tissue composed of the seminoma type of cell. C. On the left is a glandular structure lined with columnar cells such as is often found in the mixed celled (teratoma) type of tumor. To the right and separated by a band of connective tissue are the typical seminoma cells supported in a fairly abundant connective-tissue stroma. D. Another field showing a great number of seminoma cell group in a connective tissue matrix and associated with a small island of cartilage on the left.

*fine lymphoid stroma and are identical in every way with the "seminoma" type of cell (Figs. 4 and 5)*

The other type of epithelioid proliferation which is very prominent consists of large polygonal cells with irregular vesicular nuclei, most of which show a single large nucleolus. The intercellular substance is very scanty. Blood-vessels are numerous. Hemorrhagic and necrotic areas are present giving the cells in some areas a perithelial arrangement. These cells on the whole have a distinctly alveolar arrangement. Islands of squamous cells are present in various places.

The enlarged gland, noted above, which was removed from between the aorta and vena cava at operation, shows entire replacement of normal elements by metastatic cells of various types in which the epithelial elements, as usual, predominate. The remaining glands show hemorrhage and endothelial proliferation but no definite areas of malignancy. Serial sections from the spermatic cord and globus major show no metastases.

*Conclusion*—The condition present therefore is one of true teratoma in which the

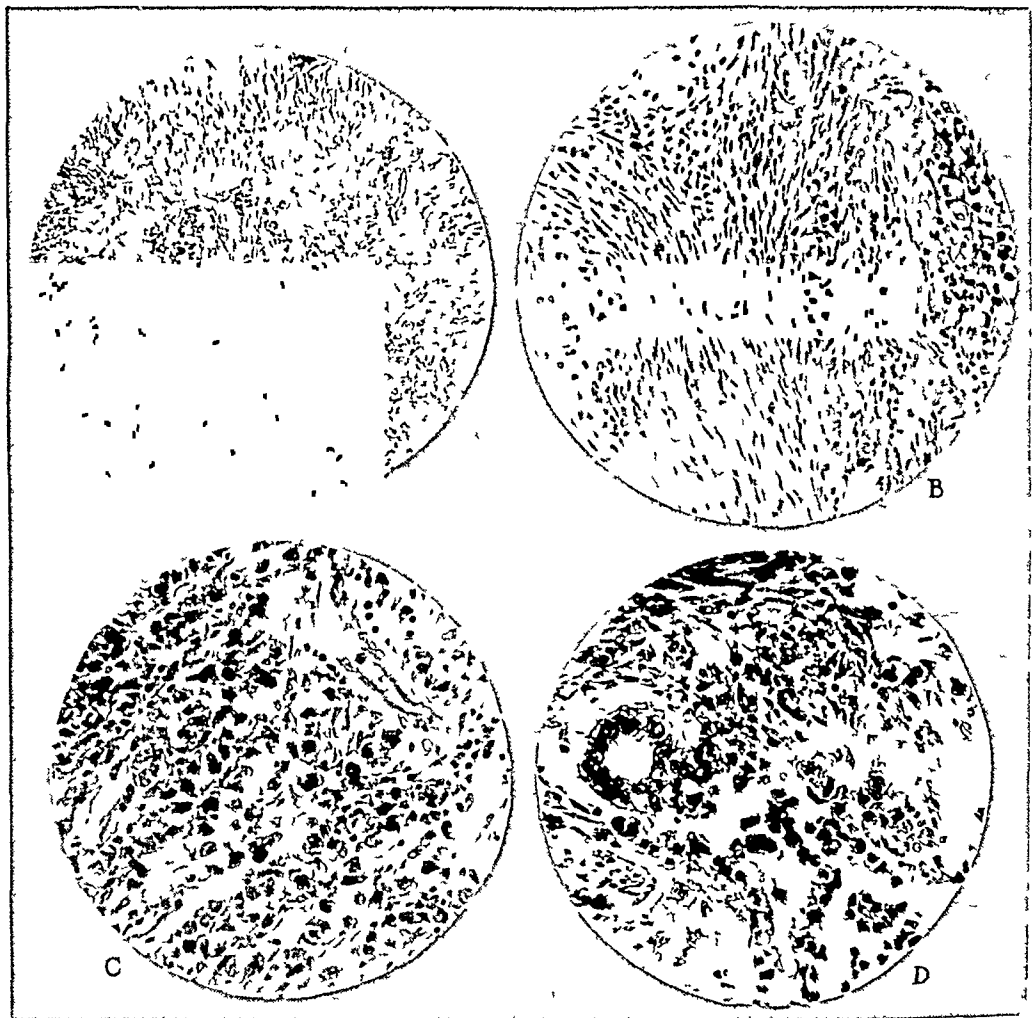


FIG. 5—Photomicrographs of characteristic areas of specimen No. 2356. A Photomicrograph (low power) of another area showing numerous groups of the seminoma type of cell in a connective tissue matrix. B Photomicrograph (high power) showing two islands of cartilage at the left bounded by dense connective tissue. At the right margin are seminoma cells with the characteristic lymphoid stroma. C Photomicrograph (high power) showing an island of the typical seminoma cells. Note the large heavily stained nuclei and the small amount of cytoplasm; at the right margin are some lymphocytes which as a rule accompany the seminoma or unicellular type of tumor. D Photomicrograph (high power) showing the occurrence of a glandular structure adjoining a group of seminoma cells.

epithelial elements predominate. Definitely adenocarcinomatous areas, sarcomatous areas and typical areas of the "seminoma" type of tissue are present in abundance intermixed with cartilage, bone, squamous-cell nests, and various types of cystic cavities lined by epithelium. The photomicrographs (Figs. 4 and 5) illustrate clearly the association of "seminoma" and other types of tissue present in abundance in the same tumor.

*Diagnosis*—Teratoma testis with glandular metastasis.

CASE IX—T. K., No. 22-723. Age thirty years. Six months previously, patient noticed some pain in right testicle. Six weeks later noticed small button-like swelling

## MALIGNANT TUMORS OF THE TESTICLE

This has rapidly grown in size up to the present time. A radical operation for teratoma testis was performed with resection of the pre-aortic lymph-glands. There was an uneventful recovery, the patient leaving the hospital on the twentieth day post-operative. Patient died with large retroperitoneal metastasis eleven months post-operative.

*Gross Pathology*—The tumor is enclosed within the smooth thickened capsule measuring  $10.5 \times 7.5 \times 6$  cm. Section through the tumor shows a fairly soft, grayish-yellow tissue mass which bulges on cut surface. There is no definite architecture. Irregular oedematous bands of connective tissue form a stroma in which lie small nodules of cartilage. Numerous small cystic areas varying in size from 1 to 5 mm in diameter and several fairly circumscribed, opaque, homogeneous cellular areas. In the central



FIG. 6.—Photomicrographs (low power) of areas chosen at random from the typical 'seminoma' type of tumors exhibiting no other types of tissue. Note the solid medullary type of growth and the resemblance borne to the spermatocytes in Fig. 8. A. Section showing complete absence of the usual characteristic lymphoid stroma. The cells are supported on a scant connective-tissue framework which likewise carries the blood supply. B. Section showing an unusually abundant lymphoid infiltration, the seminoma cells occurring in small islands. The occurrence of the lymphocytes in this type of tumor are part of the tumor growth and not of any inflammatory reaction.

portion is an irregular, yellowish area of necrosis. On two sides of this area are two hemorrhagic zones.

*Microscopic Pathology*—The solid portions of the tumor are composed of connective tissue which shows oedema and hyaline changes in some areas, while in others it is quite cellular. Irregular bands of smooth muscle are frequently found lying in connective tissue. Masses of embryonal cartilage are scattered diffusely throughout the sections. There are many cystic and glandular structures lined by squamous or columnar epithelium. Small islands of squamous epithelium, neuro-epithelium, and ganglion cells are found. An occasional glandular structure with papillary infoldings may be seen. Several sections show marked proliferation of epithelium in small alveolar gland structures. This type of epithelium is found invading the stroma and forming small nests of cells, which show numerous mitoses—a characteristic picture of malignancy.

*Diagnosis*—Teratoma testis, malignant.

CASE X—L. S. No. 25-22. Age twenty-five years. Aching and swelling noted in the right testicle five months ago. The tumor has continued growing gradually. A radical operation was performed for teratoma testis with resection of the pre-iliac and pre-aortic lymph-glands. During convalescence the patient developed a Virchow's node the third week post-operative. Pathological examination showed the same type of tumor as testicular growth with one metastasis to lymph-gland. The patient, however, grew weaker and continued to lose weight, and died suddenly ten weeks post-operative.

*Gross Pathology*—Specimen consists of large ovoid mass measuring 8x10 cm. Upon section a cellular surface with numerous cystic spaces is seen. Stromas and partitions of fibrous tissue are seen coursing through the tumor, giving it a reticulated appearance.

*Microscopic Pathology*—Examination shows in certain areas testicular tissue, the tubules of which are normal, but the interstitial tissue is irregularly oedematous. Scat-

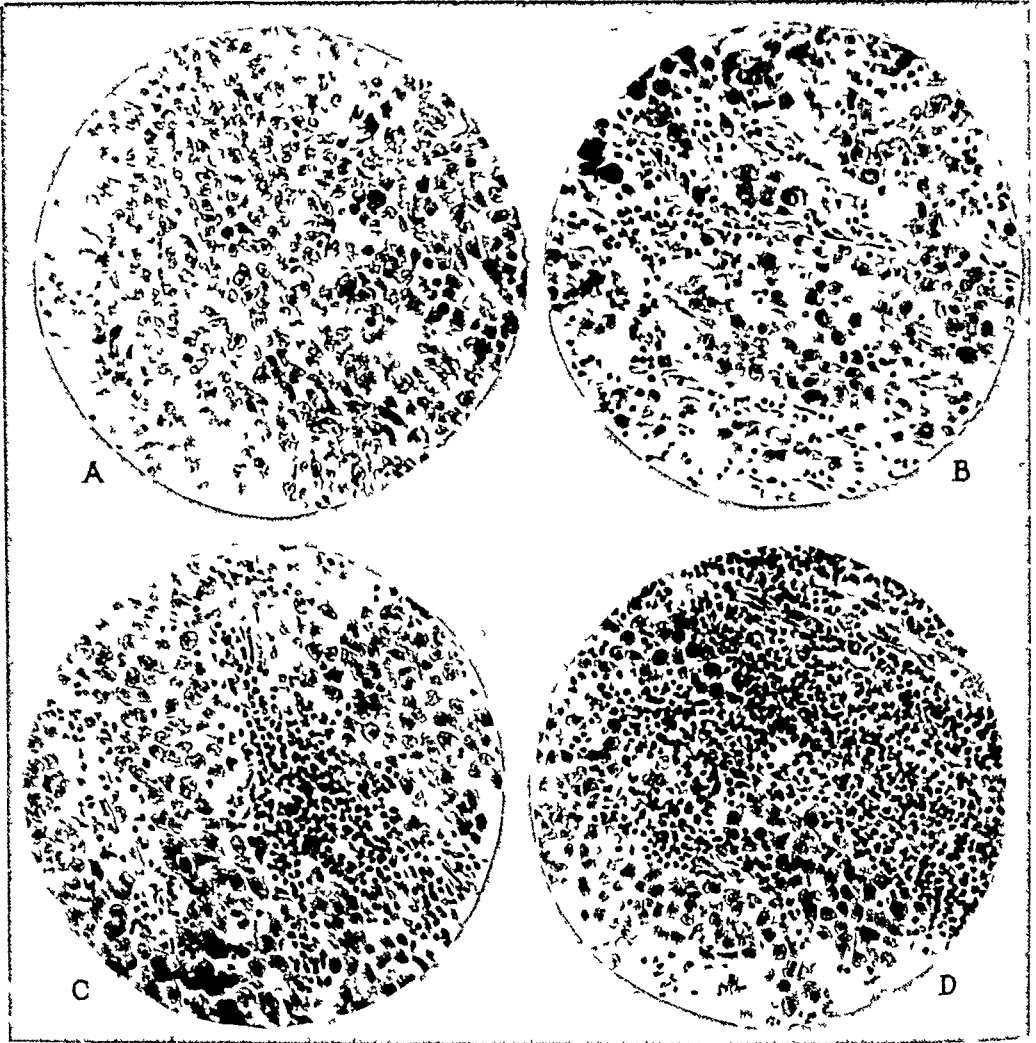


FIG. 7.—Photomicrographs (high power) from seminoma type of tumors such as is illustrated in Fig. 2. Note that the lymphoid stroma in these groups may vary from a complete absence, as shown in A to a marked preponderance, as in D. The tumor cell type shown in these photomicrographs was thought by Chevasu to be identical with the spermatocyte and he therefore designated these tumors as seminomas.

tered in the testicular tissue, and also independent of it, are areas of varying size occupied by a new growth of abnormal epithelial cells growing in a papillary adenomatous pattern. The cells are relatively large with clear-cut nuclei, round to oval in shape, in general presenting relatively a small amount of chromatin material and with a single, often conspicuous nucleolus. The cytoplasm varies in amount and in general appears finely reticulated. Mitoses are frequent. In the fibrous stroma, associated with the new growth, is considerable infiltration of lymphocytes and plasma cells. In some of the areas, carcinoma degeneration, especially of the more central portions of the nodules, is seen.

## MALIGNANT TUMORS OF THE TESTICLE

In other sections, but still more or less intermingled with the carcinoma, are areas of cyst-like structures lined by cuboidal epithelium, others by high columnar epithelium, and still others by squamous epithelium, the latter showing keratohyalin changes and keratinization of the inner layers. Associated with the latter are a few areas presenting degeneration and foreign body giant-cell reaction. An area showing strands of smooth muscle is seen. While no definite cartilage is seen, a few areas of connective tissue have become diffusely hyalin and suggest a pre-cartilaginous reaction.

Section through a gland removed from the spermatic cord during radical operation shows marked infiltration with tumor cells arranged in loose papillomatous pattern upon a hyalinized connective-tissue base. The cell types are similar to those of the primary tumor.

*Diagnosis*—Teratoma testis with papillary adenocarcinoma and with glandular metastasis.

### II Seminomata

CASE XI—E. S. Age thirty. Two months previous, injury to right testis. Testis tender but not swollen. Within a few days it swelled up to twice its normal size, remained stationary for a month, and then continued to increase in size—duration only two months. Orchidectomy was performed by Doctor Eloesser, San Francisco.

Pathological examination showed malignant tumor of the testicle. One month later the patient was re-operated and radical operation performed with resection of the lymph-glands along the vena cava and aorta. Uneventful recovery except for one attack of vomiting on the seventh day post-operative, causing a retroperitoneal hemorrhage. The patient is living and well eight years post-operative ‡.

*Microscopic Pathology*—Sections of tumor show tissue, consisting almost entirely of very large polygonal cells with large deeply staining vesicular nuclei. The masses of cells are imperfectly divided by thin connective-tissue partitions in which are large blood-vessels. In sections from the proximal end of cord one finds in the vicinity of some of the nerves small accumulations of large cells, very suspiciously like tumor cells.

*Diagnosis*—Seminoma of the testis.

CASE XII—Mr. F., No. 920. *Microscopic Pathology*—Examination shows a typical picture of the seminoma pattern. There is the solid type of cellular growth supported on a dense lymphoid stroma, the latter appearing more numerous in some areas than the epithelial cells. The large epithelial cells resemble the spermatoblast type seen in the seminiferous tubules which may also be seen in the margin of the section.



FIG. 8.—Photomicrograph (high power) of a section through a normal adult testicle, illustrating the spermatogenic cycle. Compare the spermatocytes in this figure with those illustrated in the preceding photomicrographs of 'seminomas'.

‡ Hinman, Frank. Radical Operation for Teratoma Testis with Report of Five Cases. Surg. Gyn. and Obs. 1919, vol. XXXIII, p. 195.

The growth extends between the remaining tubules and not within their lumen. No other type of tissue can be found in the slides examined.

*Diagnosis*—Seminoma of testis

CASE XIII—V S P, No 2370. Age twenty-nine. History of growth of right testicle to size of lemon in five months, accompanied by pain and interfering with walking. Radical operation for teratoma testis was performed with resection of the glands from the pre-aortic region. There was an uneventful recovery. The patient died twenty months post-operative.

*Gross Pathology*—Specimen consists of an oval mass measuring 10 cm in its greatest diameter. The cut surface presents a fairly uniform grayish-white cellular picture

with numerous areas of necrosis and degeneration with formation of small cavities. Strands of connective tissue divide the tumor mass into irregular indistinctly separated lobules.

*Microscopic Pathology*

—There is seen a large polygonal cell with a faintly staining, slightly granular cytoplasm, a large irregular oval nucleus with a deep staining chromatin network and rather coarse chromatin granules and with one or two nucleoli. The cells are closely packed together, with a very small amount of intercellular substance. There are heavy coarse connective-tissue bands separating the tumor cells into large groups. The blood-vessels follow these bands

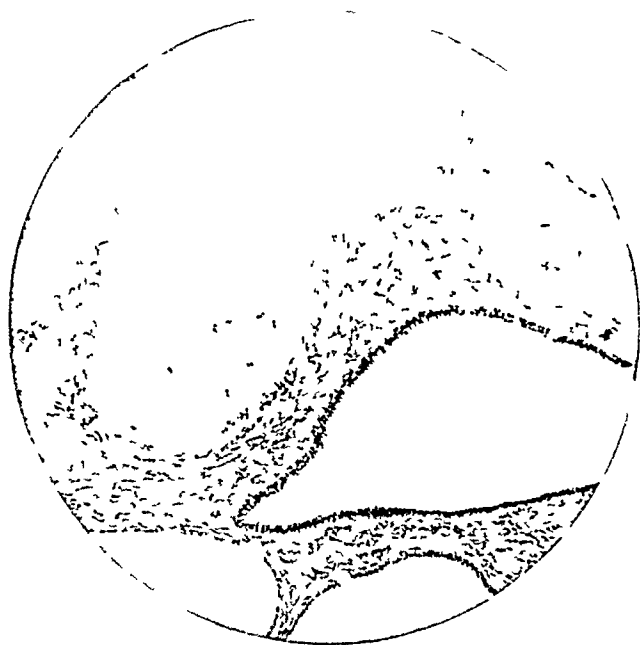


FIG 9—Photomicrograph (low power) of a teratoma showing area of cartilage and three cystic spaces, each lined with a different type of epithelium—cuboidal, short columnar and high columnar.

and are also seen passing through the midst of the mass of tumor. They are lined by a single endothelial layer. There is quite a tendency to disintegration, in some areas due probably to poor blood supply. These areas show considerable blood pigment and lymphocytic infiltration. Mitotic figures are abundant.

A lymph-gland removed during radical operation from between the aorta and vena cava shows itself to be entirely replaced by cells of the same type as in the testicular tumor.

The type of tumor cell closely resembles the spermatoblasts, from which Chevasse derives this type of tumor.

*Diagnosis*—Seminoma of the testis with glandular metastasis.

CASE XIV—Mr L., 20-2404. *Gross Pathology*—Specimen consists of testicle, is roughly egg-shaped, and measures 8 cm in its greatest diameter. The cut surface is quite mottled and shows large areas of degeneration, and is quite hard in some areas due to tough cartilaginous-like connective tissue. In between these areas is a grayish-white granular material.

*Microscopic Pathology*—The type of cell found is large, round, or polygonal, with a faintly staining or non-staining clear cytoplasm, a relatively large nucleus, vesicular in

## MALIGNANT TUMORS OF THE TESTICLE

character, with one or more nucleoli. Mitotic figures are abundant. The cells are laid down in large fields quite closely packed together in a minimum of connective tissue. Throughout these fields are broad irregular bands of connective tissue. Here and there are groups of cells or debris which stain almost black. There are quite a few fairly large areas of degeneration and these are mostly in the form of caseation. Careful search fails to reveal definite evidence of the presence or preexistence of any specialized tissue outside

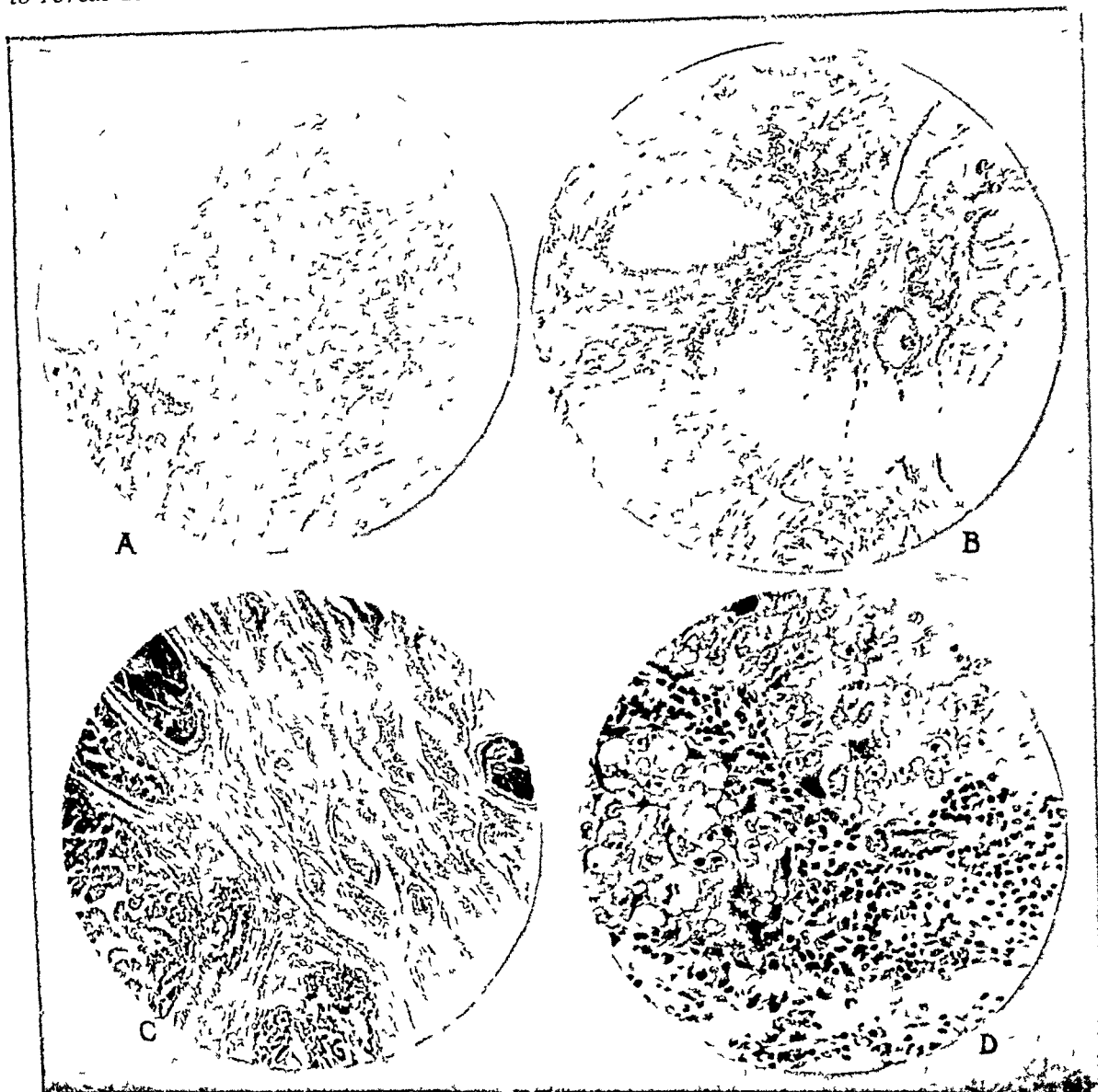


FIG 10—Photomicrographs of representative areas in mixed tumors (teratoma) of the testicle. A Low-power view of area showing a connective-tissue stroma showing islands of cartilage, nerve-ganglion cells. B Low-power view showing the various types of glandular structures in a connective-tissue matrix. C Low-power view showing a carcinomatous area in a teratoma encroaching on the normal testicular tissue. D High-power view showing large vesicular carcinoma cells in a teratoma. Note the presence of a lymphoid stroma in this case. This demonstrates that such a lymphoid stroma can occur in either the seminoma or mixed cell type of tumor.

of the supporting connective-tissue framework. Differential staining proves the supporting tissue to be fibrous.

### Diagnosis—Seminoma of the testicle

CASE XV—A. M. 20-2643. Age thirty-four years. History of trauma to left testicle five years ago. Seven months ago noticed left testicle increasing in size and that it had become stony hard in consistency. A radical operation was performed with resection of the glands along the spermatic vessels and iliac artery up to the aorta. There was a chain of enlarged glands running up the aorta, all of which could not be



resected Uneventful recovery The pathological examination of the glands removed showed metastasis with the same type as the testicular growth The patient received several X-ray treatments over the abdomen during a period of one and one-half years Patient living and well one and one-half years post-operative

*Gross Pathology*—Specimen consists of an ovoid mass, 5 × 7 cm The epididymis is entirely obliterated by tumor Upon section is seen a very uniform, smooth, whitish cellular surface with occasional fine bands of connective tissue running through the growth No necrosis is seen The growth almost completely fills the tunica albuginea except in one area where a small band of normal testicle is seen

*Microscopic Pathology*—Examination reveals a dense medullary type of growth with irregular strands of reticular connective tissue supporting numerous lymphoid cells The



FIG. 11—A Low-power view showing an area in a mixed tumor of the testicle showing an island of squamous cell formation along with other glandular elements B High power view of margin of island of squamous cells as shown in centre of preceding illustration Note the characteristic cornification and keratohyalin granulation

tumor cells are large and uniform closely resembling spermatoblasts The protoplasm is abundant, finely granular and faintly stained The nuclei are large round or oval possessing one to two nucleoli The chromatin presents a characteristic stippled or granular arrangement Numerous mitoses are seen, many of them atypical An occasional multinuclear giant cell, resembling those of tuberculosis, is seen The growth follows no definite pattern and seems characteristic of the seminoma of Chevasu

A metastatic gland removed from the bifurcation of the aorta during radical operation presents extensive malignant infiltration with cells characterizing the primary growth

*Diagnosis*—Seminoma of the testis with glandular metastases

CASE XVI—J L, 21-2369 Age fifty-two years Inguinal lymph-glands palpable since the age of ten years At the age of twenty there was an egg-sized lump in right groin, it remained this size for almost thirty years For the last several years it has grown in size Six months ago additional lumps formed in both loins until at present they are of enormous size

*Gross Pathology*—Specimen consists of two huge pieces of material one being as large as a child's head The tumors are quite bosselated and show a marked degree of degeneration, especially at the centres The under surface or the line of division in separating the tumors from the body, shows soft necrotic tissue, indicating that tumor tissue had been left behind

*Microscopic Pathology*—Sections show great masses of tumor cells closely packed together with a scanty reticulum and separated off into large fields by very heavy

## MALIGNANT TUMORS OF THE TESTICLE

connective-tissue trabeculae There is a great deal of degeneration with loss of substance or in the form of coagulative necrosis Blood-vessels are not especially frequent, though it is not uncommon to find large spaces engorged with blood and without blood-vessels surrounded by the tumor cells The individual cells are polygonal The cytoplasm is quite clear, the cell outline is quite sharp and the nucleus relatively large The nuclei seem vesicular, the chromatin is rather coarse Nucleoli are not definitely seen in the majority of cells Mitoses not very abundant Here and there may be seen tumor cells varying from one to five times in size to the ordinary cell Occasionally these are multinucleated The picture seems like a lymphosarcoma and in many respects resembles endothelioma With the clinical findings pointing to a testicular origin, the case can well be classed with the seminoma of the testicle

*Diagnosis*—Seminoma of testicle with huge inguinal metastases

CASE XVII—No 22-1337 *Gross Pathology*—Specimen consists of two pieces of tissue which when put together make half of an egg-shaped mass, measuring 8 x 5 cm The cut surface is very soft and spongy, and varies in color from a slightly yellowish-white at the capsule to an iron-gray in the centre Lobulations can be made out At one pole is an area of degeneration with some liquefaction

*Microscopic Pathology*—Sections show complete loss of architecture and replacement with tumor tissue The cells are polygonal or round, have rather sharp cytoplasmic outline with relatively scanty amount of cytoplasm, rather deep staining vesicular nuclei with very pronounced nucleoli Mitoses are frequent Blood-vessels are numerous The connective tissue supporting the framework is rather abundant, but in the form of rather delicate reticulum In most of the section there is a small lymphocyte background or infiltration, the cells being limited to the connective-tissue partitions and framework Careful search fails to reveal anything that resembles thyroid tissue or epithelial tissue such as glandular structures or fibromuscular organs

*Diagnosis*—Seminoma of the testicle

CASE XVIII—I S, No 22-1377 Age twenty-seven years Born with an undescended testicle situated anterior to the external ring, at times tender, but seldom painful Occasional pain and swelling of the testicle, subsiding in a few days, last attack being three months ago

*Gross Pathology*—Specimen consists of a flattened, roughly spherical mass Upon section there is seen two distinct parts or lobules, one about half the size of the other The testis appeared fibrotic except for a narrow margin of normal brownish gland tissue opposite the epididymis The body of the epididymis was replaced by a solid opaque circumscribed tumor mass, which appeared to be separated from the testicle by a definite capsule The globus major and minor were preserved

*Microscopic Pathology*—Sections show large, circular tumor cells in small clumps, about an equal amount of lymphoid cells and an abundant, rather dense and hyalinized connective tissue The large tumor cells have a very sharp cytoplasmic outline The cytoplasm is clear or very finely granular The nuclei are rather large with the chromatin coarsely distributed Mitoses are frequent The lymphoid cells are not inflammatory in origin but have the appearance of the true lymphoid cell of the lymph-gland The supporting connective tissue contains many cells which suggest an endothelial nature and in many instances there are peculiar circular clumps of cells in some cases suggesting giant cells and in others an abortive attempt to produce a blood-vessel

*Diagnosis*—Seminoma of the testicle

CASE XIX—C D, No 23-274 Age forty years Painless swelling of the right testicle of one year's duration Pain above the iliac crest of four months' duration, gastric distress of two months' duration

*Gross Pathology*—Specimen consists of testicular mass measuring 8 x 4 cm Upon cross-section about one ounce of clear straw-colored fluid escaped from the tunica vaginalis The cut surface shows a solid granular tumor mass, being grayish-white in color somewhat friable

*Microscopic Pathology*—Examination shows homogeneous fields of large circular tumor cells, having a sharp protoplasmic outline. The cytoplasm is clear or finely granular. The nuclei are rather large, the chromatin coarse. Mitoses are frequent. Here and there may be seen occasional interstitial strands of connective tissue, which in some areas contains large vesicular cells, it also contains small blood-vessels. The picture is typical of the seminoma of Chevasu. The lymphoid stroma so often seen in these tumors is lacking in this case.

*Diagnosis*—Malignant tumor of the testicle—seminoma, with hydrocele of the tunica vaginalis and cord.

*Case XX*—A. N., No. 23-829. Age forty-five years. Injury to the right testicle three and one-half years ago. The testicle gradually increased in size and became stony hard in consistency. Orchidectomy five months ago. Pain and mass in epigastrium.

*Gross Pathology*—Specimen consists of the major portion of a testicle. The cut surface shows numerous large, sharply demarcated, angulated areas varying in size from a pin point to 2 cm, which are yellowish-gray, soft, friable and are more or less degenerated.

*Microscopic Pathology*—Examination shows solid, large cell, medullary type of growth characteristic of the seminoma. So much necrosis and superimposed infection are present as to rather mask the picture. The lymphoid stroma, which varies greatly in different cases, is not very noticeable here. There is some effort at scar tissue formation about the edges of the necrotic areas. The tumor cells resemble closely the spermatocytes. The cells are large and vesicular, each with a large, round or oval nucleus, darkly stained or finely stippled, containing one to two nucleoli.

*Diagnosis*—Seminoma of the testicle.

*Case XXI*—No. 25-264. *Gross Pathology*—Resembles closely the shape of normal testicle, being seven and one-half in its greatest diameter. The tumor is well encapsulated, there being no infiltration of the tunics. The tumor externally is smooth, its consistency is quite firm. On section is seen a solid granular surface, characteristic of the seminoma. No normal testicle is seen.

*Microscopic Pathology*—Examination shows a solid medullary type of growth con-



FIG. 12.—Photograph of patient showing ulcerated inguinal metastases from a seminoma type of growth. Metastases to inguinal glands are unusual and occur usually when the testicular tumor has involved the skin of the scrotum which it rarely does. The testicular lymphatics drain directly to the pre-aortic lymph glands and therefore are the ones most usually involved.

# MALIGNANT TUMORS OF THE TESTICLE

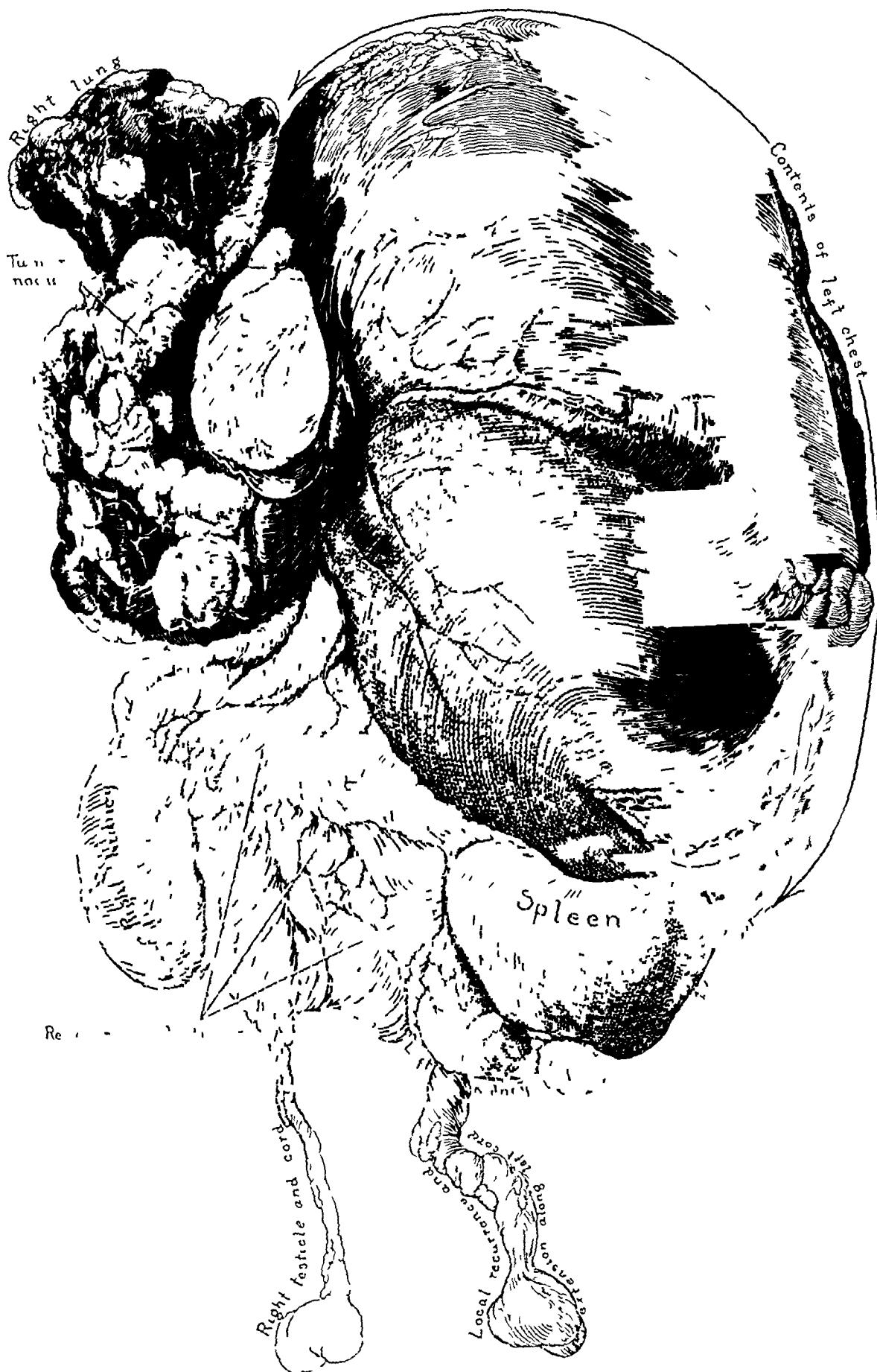


FIG. 13.—Drawing from autopsy (Case 22) illustrating the usual mode of metastases in malignant tumors of the testicle. Metastases in this case occurred to the retroperitoneal lymph glands, the liver and the lungs. The left chest was completely filled by one huge metastatic tumor mass with displacement of the heart to the right.

## HINMAN, GIBSON AND KUTZMANN

sisting of cells containing large round nuclei and an indistinct cytoplasmic border. The nuclei contain one to two nucleoli and the chromatin material shows an uniform stippling similar to that of the spermatoblast. A slight amount of lymphoid stroma can be seen in some areas. A few areas of necrosis are present. There are frequent mitoses. At one margin of the section normal appearing epididymis is made out. No other types of tissues are seen.

*Diagnosis*—Seminoma of the testicle

CASE XXII—*Note* The following case is included in this series because of the typical pathology found at autopsy in the metastases.

E. C. Age ten years. History of injury to the left testicle six months ago, followed by tumor formation with left orchidectomy five months ago. The patient entered the University Hospital because of pain in the left chest, cough, malaise and weakness. Examination showed recurrent nodule in the left scrotum.

Autopsy showed diffuse metastases to the retroperitoneal glands, liver and filling almost the entire chest.

*Microscopic Pathology*—Sections from the nodule in the left scrotum show a richly cellular tissue composed of numerous undifferentiated polyhedral cells supported by a connective-tissue stroma. The cells vary in their arrangement occurring in some places diffusely or in sheets, in other places, and quite frequently as more or less continuous linings of numerous small irregular spaces. The latter by an anastomosing network of connective-tissue strands give the growth an alveolar-like structure. The cells lining these spaces, as well as those diffusely present, are in general poorly defined, possessed of very little cytoplasm and for the most part made up almost entirely of large vesicular nuclei. The latter contain a varying amount of chromatin, usually finely granular and fairly evenly distributed. Some of the nuclei are hyperchromatic. Some possess nucleoli. Mitoses are frequent. The stroma consists of finer and coarser strands of a pale fibrillar tissue. Stroma and parenchyma are present in about equal amounts, though varying somewhat in proportion. Scattered here and there throughout the stroma are a few small, rather darkly staining cells consisting of lymphocytes, neutrophils and degenerating tumor cells. The picture is one suggestive of the seminoma.

Sections from the various scattered metastases present a similar picture.

*Diagnosis*—Seminoma (recurrent) of the left testicle with metastases to retroperitoneal glands, liver and lungs (thorax). (Fig. 13.)

### BIBLIOGRAPHY

- Bizy. Teratome du testicule. Bull. et Mem. Soc. de Chir. de Paris, 1919, vol. XLV, p. 952.  
 Birch-Hirschfeld. Lehrb. d. Path. Anat., 1877, p. 1204.  
 Birch-Hirschfeld. Arch. f. Heilk., 1868, vol. IX, p. 537.  
 Cavazzini. U. d. Entstehung d. Teratoidé d. Hodens. Beitr. z. Path. Anat., 1907, vol. LI, p. 413.  
 Chevassu. Tumeurs du testicule. These de Paris, 1906.  
 Chevassu et Pique. Teratome du testicule. Bull. Soc. d. Chir., Paris, 1898, vol. XLIV, p. 60.  
 Cooke. Chorioepithelioma of the Testicle. Bull. J. Hopkins Hosp., 1915, vol. XLVI, p. 215.  
 Debernardi. Beitr. z. Kenntniss d. Malign. Hodengeschwulste. Beitr. z. Path. Anat., 1906, vol. XLIX, p. 534.  
 Ewing. Teratoma Testis and its Derivatives. Surg., Gyn. and Obs., 1911, vol. XLII, p. 230.  
 Ewing. Neoplastic Diseases, 1922.  
 Frank. Die Histogen. Ableitung der Hodentumoren. Frankfurt Ztschr. f. Path., 1911, vol. IX, p. 206.  
 Frank. Chorioepithelomatous Proliferations in Teratomata. J. A. M. A., 1906, vol. XLVI, p. 248.

## MALIGNANT TUMORS OF THE TESTICLE

- Geist and Thalheimer Histopathology of Carcinoma of Testicle ANNALS OF SURGERY, 1917, vol lxxvi, p 571
- Hardouin et Patel Deux observations de tumeur du testicule chez l'enfant Bull et Mem Soc Anat de Paris, 1914, vol lxxix, p 150
- Hinman, Frank The Operative Treatment of Tumors of the Testicle with the Report of Thirty Cases Treated by Orchidectomy J A M A, 1914, vol lxi, pp 2009-2014
- Hinman and Gibson Tumors of the Epididymis, Spermatic Cord, Etc Arch Surg, 1924, vol viii, p 100
- Hinman, Gibson and Kutzmann Radical Operation for Teratoma Testis Surg, Gyn, and Obs, 1923, vol xxxvii, p 429
- Johnson Cystic Disease of the Testis in an Infant and Probably Congenital Trans Path Soc London, 1856, vol vii, p 241
- Kutzmann and Gibson Malignant Tumors of the Testicle in Children ANNALS OF SURGERY, 1923, vol lxxviii, p 761
- Kober Sarcoma of the Testicle Am J Med Sci, 1889, vol cxvii, p 535
- Kocher Krankh d Mannl Geschlechtsorganen Deut Chir Lief 50 B, 1887, p 414
- Langhans Deut Chir Lief 50 B, 1887, p 414
- Miyata Zur Kenntniss der Hodengeschwulste Arch f Klin Chir, 1913, vol ci, p 426
- O'Crowley and Martland New Growths of the Testis Surg, Gyn and Obs, 1919, vol xxviii, p 486
- Pick U Neubildungen am genitale bei zwittern Arch f Gyn, 1905, vol lxxvi, p 195
- Pick Zur Frag d Entstehung d Chorioepithelioms aus angeboren anlagen Arch f Path Anat, 1905, vol clxxx, p 172
- Ribbert Die Lehr u d Geschwulsten Bonn, 1904
- Sakaguchi Zur Kenntniss der Malignen Hodentumoren vor allem der epithelialen Deut Ztschr f Klin Chir, 1913, vol cxv, p 294
- Schultz and Eisendrath The Histogenesis of Malignant Tumors of the Testicle Arch Surg, 1921, vol ii, p 493
- St Donat Nouvelles Observ sur la pratique des accouchements (Pierre Amand) Paris, 1715, p 79 (Cit by Verneuil)
- Talavera Lymphadenome du testicule Thèse de Paris, 1879
- Tizzoni Contrib allso studio dei tumori rivista Clin di Bologna, 1876, vol vi, p 145
- Vecchi Cisti dermoide del testicolo Clin Chir, Milano, 1912, vol xx, p 207
- Verneuil Tumeurs du Testicule Bull Soc Chir de Paris, 1867, vol ii, s, vol vii, p 355
- Wilms Embrvone u embryoide Tumoren d Hodens Deut Zeitschr f Chir, 1898, vol xlix, p 1
- Wilms Die Teratoide geschwulste d Hodens Beitr z Path Anat, 1899, vol xix, p 233
- Wilms Die Mischgeschwulste Berlin, 1902

# RETROPERITONEAL HERNIA<sup>†</sup>

By WILLIAM E LOWER, M D

AND

C C HIGGINS, M D

OF CLEVELAND, OHIO

FROM THE CLEVELAND CLINIC

ALTHOUGH retroperitoneal herniation of the intestines may occur through the foramen of Winslow or into the fossæ in the duodenal, cæcal or sigmoid regions, the types which occur in the region of the duodenal-jejunal flexure comprise the majority of the reported cases

The infrequent occurrence of these herniæ is indicated by Nagel's publication in 1923<sup>12</sup> He reported one hundred cases of left and twenty-eight

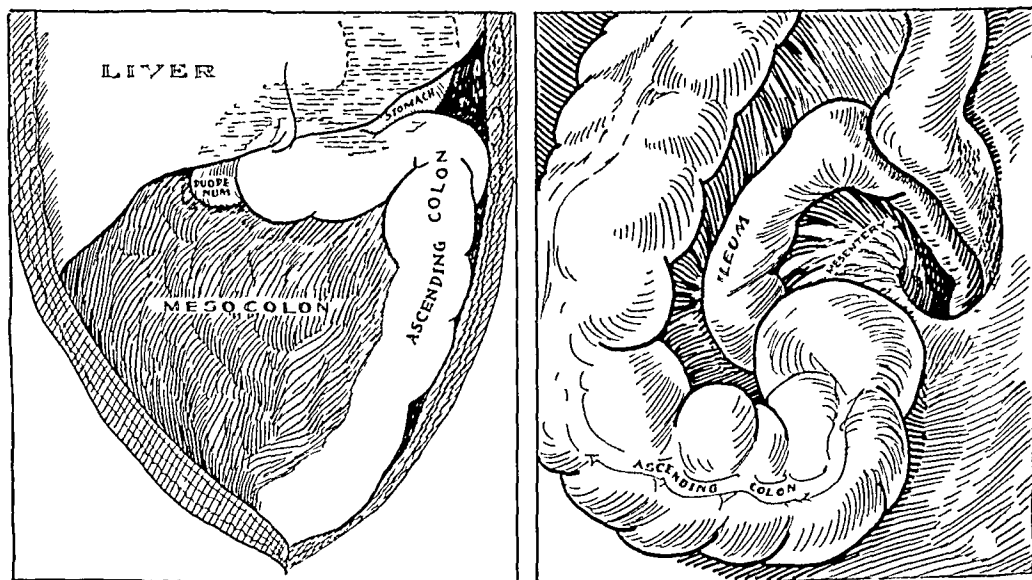


FIG 1—Right paraduodenal hernia a Appearance on opening abdomen b Ascending colon reflected showing hernia into right paraduodenal fossa

cases of right paraduodenal hernia In view of these facts, it has appeared to us that it might be of value to add two more, one of each type, to the reported cases, and to offer a brief discussion of the etiology, diagnosis and treatment of this condition

## REPORT OF CASES

CASE I—A girl, thirteen years of age, entered the hospital on September 25, 1922, complaining of abdominal distention and vomiting The family and personal histories gave no information pertinent to the existing condition, and until nine weeks before the girl's health had been excellent At that time she began to vomit and distention of the abdomen became evident, most of which disappeared after enemas The nausea occurred usually at night There was no fever and no severe pain The bowels were costive The child complained of a general feeling of distress throughout the entire abdomen

\* Read before the American Surgical Association, May 5, 1925

## RETROPERITONEAL HERNIA

Physical examination revealed an emaciated girl with the abdomen markedly distended, a palpable mass which felt like intestines matted together was present in the right lower quadrant. No tenderness was elicited. On auscultation over the mass a gurgling sound was audible while percussion yielded a resonant note. The blood and urine were normal.

The pre-operative diagnosis was partial intestinal obstruction from appendicitis, tuberculosis or a dermoid cyst.

Operation—The abdomen was opened through a right rectus incision. Exploration

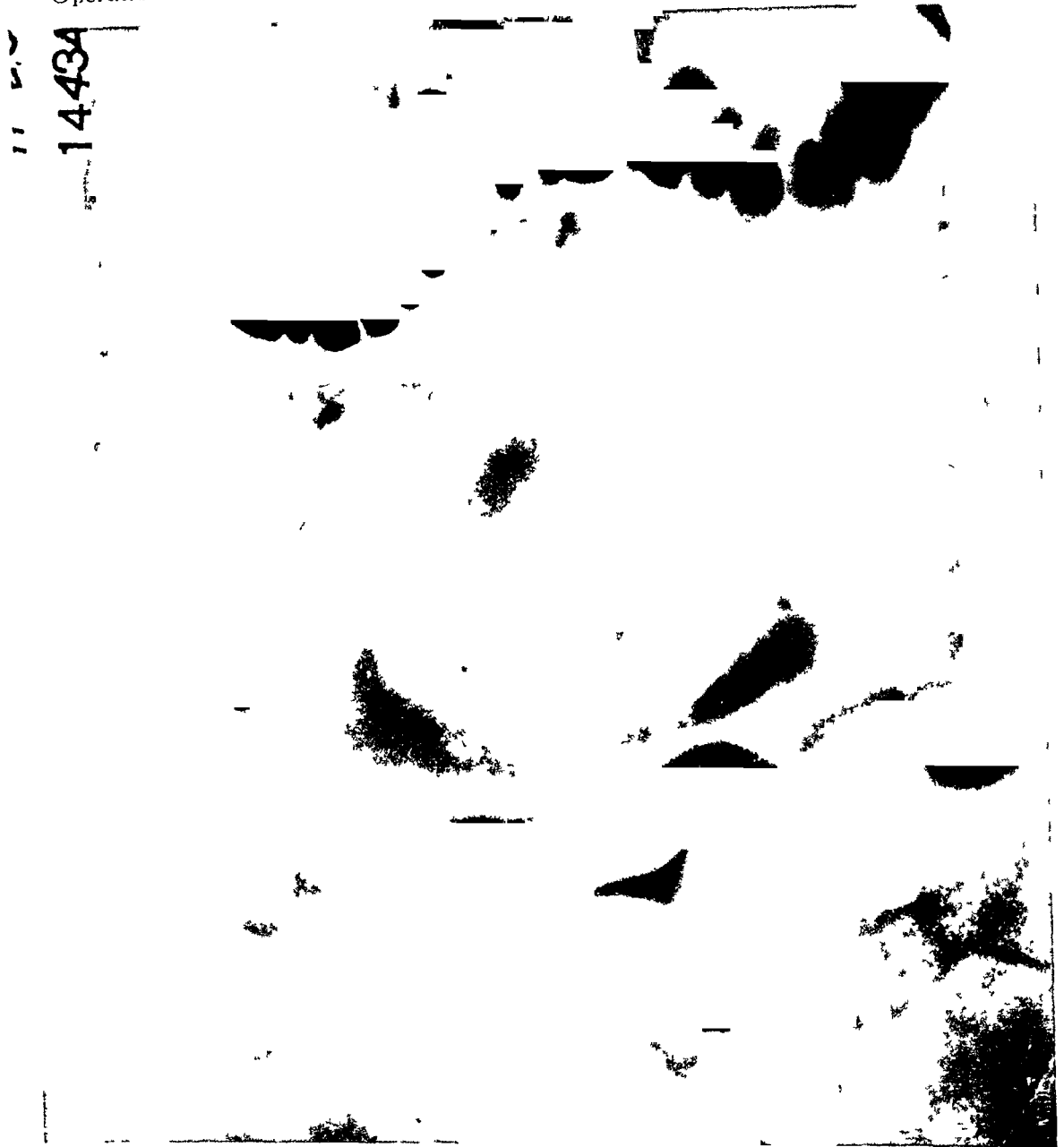


FIG. 2—Plate before operation showing deformity of cecum

revealed the abdominal cavity free from small intestines and a portion of the ascending colon all of which occupied the retroperitoneal space (Fig. 1). After elevating the ascending colon and mesentery, the point of herniation was located. The superior mesenteric artery was present on the anterior margin of the fold while the neck of the sac was just below and to the right of the fourth lumbar vertebra and in close approximation thereto. The sac which was very large extended from the margin of the lateral abdominal wall past the midline.

The intestines were pulled downward and to the left below the superior mesenteric



artery and the hernia was reduced. The neck of the sac was ligated with catgut and reinforced with silk.

Convalescence was satisfactory except for the development of encephalitis lethargica. The patient was discharged on November 2, 1922, and had had no abdominal disturbance when last heard from on January 9, 1925.

CASE II—This patient was a laborer, fifty years of age. He entered the hospital on November 24, 1924, complaining of pain in the abdomen, abdominal distention and the passing of considerable flatus. The patient had always been perfectly well until two years before when he became aware of progressive constipation. There had been no loss of weight. Neither blood nor pus was present in the stools. He experienced a constant feeling of distress in the right lower quadrant with pain which at times was acute. He had experienced nausea but no emesis. For the preceding two days there had been some elevation of temperature.

Physical examination revealed a well-developed and normal male, weighing 150 pounds. Nothing pertaining to his present condition was elicited excepting the abdominal findings. In the right lower quadrant in the region of the cæcum, there was a large globular circumscribed mass, moderately firm in consistency. The mass was slightly movable, and was neither tender nor rigid. Blood and urine were normal. The X-ray examination revealed in the cæcum a constant filling defect which might be due to a tumor (Fig 2).

On the basis of the above findings the pre-operative diagnosis was tumor of the cæcum.

Operation—Upon opening the abdominal cavity it was found entirely void of the small intestines which were retroperitoneal. There were many adhesions about the cæcum. Digital examination located the orifice of the sac, the anterior margin of which was occupied by the inferior mesenteric vein. The hernia was very large, extending upward toward the transverse mesocolon and outward toward the descending mesocolon. On account of the firm adhesions the hernia could not be reduced, so the sac was opened in the midline. Dense adhesions of the intestines within the sac prevented reduction, so the wall of the sac was closed and the abdomen closed in the usual manner (Fig 3). Evidently this condition had been initiated two years before and had gradually developed until the complete retroperitoneal hernia found at operation was produced. A diagnosis of appendicitis had been made two years previously, and it is possible that the dense mass of adhesions about the cæcum were due to a primary involvement of the appendix.

The patient made an excellent recovery and was in good condition three months later (Fig 4).

#### REVIEW OF LITERATURE

As far as we have been able to discover, the first recognition of retroperitoneal hernia was made in 1861 by Klob,<sup>11</sup> who described a case of right paraduodenal hernia, although in 1857 Tietz<sup>11</sup> described and illustrated retroperitoneal herniæ and in 1884 Fürst<sup>11</sup> also discussed their formation. A detailed description with illustrations of the various fossæ was presented by Moynihan in the *Annals and Gals* lectures in 1897, and in collaboration with Dobson, Moynihan again reviewed the literature in 1906.<sup>11</sup> In the more recent literature cases have been reported by Desjardins,<sup>5</sup> Wallace and Allen,<sup>21</sup> Kohlman,<sup>9</sup> Morton,<sup>10</sup> Pidcock,<sup>17</sup> Nixon,<sup>16</sup> Nagel,<sup>12</sup> Novak<sup>14</sup> and others.

#### CLASSIFICATION AND ORIGIN

Retroperitoneal herniæ may be divided into four groups, namely, duodenal, pericæcal, intersigmoid and those formed by herniation through the foramen of Winslow.

## RETROPERITONEAL HERNIA

As our cases belong in the first of these groups, we shall confine our discussion to the various types of duodenal herniæ. Moynihan<sup>11</sup> describes the following nine distinct types of duodenal fossæ:

1 *The superior duodenal fossa* lies to the left of the ascending portion of the duodenum. This fossa is present in from forty to fifty per cent of the cases of duodenal hernia. Its size is variable and adhesions or fat deposits may render it unrecognizable.

2 *The inferior duodenal fossa (fossa of Treitz)* is easily located and lies to the left of the ascending portion of the duodenum between the third and fourth lumbar vertebrae. This is present in approximately eighty per cent of the cases.

3 *The posterior duodenal fossa* lies behind the upper part of the ascending limb of the duodenum. It is present in some degree in the majority of cases.

4 *The duodeno-jejunal fossa* lies at the base of the transverse mesocolon. It may be found in from fifteen to twenty-five per cent of the cases.

5 *The inter-mesocolic fossa* occupies a position somewhat similar to that of the duodeno-jejunal fossa in that it lies at the root of the transverse mesocolon but unlike the latter, it runs horizontally along the mesocolon.

6 *The paraduodenal fossæ*, of which there are two types, lie to the left of the ascending limb of the duodenum. The inferior mesenteric vein or the superior mesenteric artery may serve as guides in locating these fossæ.

7 *The intra-duodenal fossa* may occur in the region of the duodeno-jejunal angle. It is not constantly present.

8 *The mesenterio-pancreatic fossa* lies behind the superior mesenteric artery and may be found by examining the first part of the mesojejunum.

9 *The para-jejunal fossa* also lies behind the superior mesenteric artery and is easily located in the first part of the mesojejunum; it is closely associated with the mesenterio-pancreatic fossa. Moynihan reports the occurrence of two definite cases in adults.

Many theories regarding the formation of these folds and fossæ into which herniation may occur have been proposed, chief among which are the following:

1 Traction folds (Nixon)<sup>13</sup>

2 Tense margins of the fossa combined with freedom of movement of the intestines plus peristalsis (Treitz)<sup>11</sup>

3 Embryonic origin as late descent of the cæcum

4 Failure of the root of the mesentery to unite with the posterior abdominal wall

5 Formation of pockets during intestinal rotation

6 Formation of fusion folds in fetal life

7 Elevation of the peritoneum by blood-vessels (Waldeyer)<sup>12</sup>

8 Physiological adhesions (Toldt)<sup>11</sup>

9 Mesoduodenum (remains of early folds) (Treves)<sup>11</sup>

Several of these causes for the formation of the fossa, combined with other factors, may give a logical explanation for the formation of retroperitoneal hernia.

The embryonic formation of "fusion folds" is not accepted as the origin of the fossa into which herniation occurs. These folds were described by Langei and Toldt<sup>11</sup> and later by Moynihan,<sup>11</sup> the former stating that portions of the common dorsal mesentery adhere to and fuse with the posterior abdominal wall during the progress of intestinal rotation.

From observations made in the dissection of fetuses, Nagel described the process of intestinal rotation and fixation in different successive stages. He demonstrated the adherence of the mesentery to the underlying parietal peritoneum and showed that later all evidences of the opposing surfaces tended

to become unrecognizable. Thus the parietal peritoneum covering the abdominal cavity is formed by the free portion of the mesentery.

The question now arises as to why these fossæ occur so frequently in the duodenojejunal region. In the early stages of embryological progression the superior mesenteric artery acts as an axis of rotation, the mesentery of the large and small intestines spreading out fan-wise across the abdomen (Priestess and Arey)<sup>18</sup>. If this centre of rotation is in the duodenojejunal area, the relative frequency of occurrence of this type of retroperitoneal hernia may thus be partially explained.

Late descent of the cæcum may play a part in the formation of folds in the pericæcal types, but there is not sufficient evidence to this effect.

As for Waldeyer's theory we hardly believe that this offers a logical

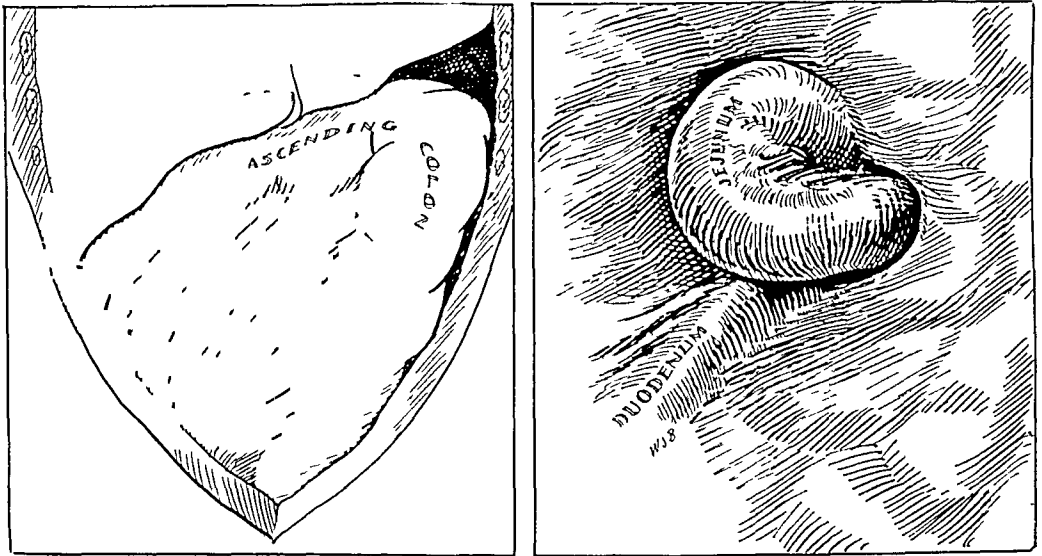


FIG. 3.—Left paraduodenal hernia. a Appearance on opening abdomen. b Greater part of small intestine withdrawn from hernia.

explanation for the development of the fossa. That the superior mesenteric artery is present in the anterior margin of a right paraduodenal hernia is true, but the presence of the artery can not account for the formation of the fossa. Similarly in left paraduodenal hernia the inferior mesenteric vein is usually present. That these vessels may form a point of resistance and thus promote the further enlargement of the fossa as the intestines are forced within it, would seem plausible, but we do not believe that the vessels are primary factors in the formation of the folds.

We agree with the views of Moynihan,<sup>11</sup> and Langer and Toldt<sup>11</sup> cited above, that the fossa into which the herniation occurs is formed by fusion folds.

*Incidence*—Retroperitoneal herniæ are uncommon. Very few cases, especially of right paraduodenal hernia, have been reported in the literature, the majority of reported cases being of the left paraduodenal type. Moynihan and Dobson<sup>11</sup> reported sixty-five cases of left and seventeen cases of right paraduodenal hernia. Short collected fourteen additional cases. Pinnose,<sup>10</sup>

## RETROPERITONEAL HERNIA

Nuzum,<sup>13</sup> Novak<sup>14</sup> and Pidcock<sup>15</sup> have also reported cases. In 1923, Nagel<sup>12</sup> collected twenty-nine cases of right paraduodenal hernia to which two more cases should be added, one that reported by Novak and Sussman<sup>14</sup> and the other our own case, thus making a total of thirty-one authentic and four unauthentic (Cooper, Píkin, Zander and Willes)<sup>16</sup> cases, and to Nagel's collection of 100 cases of left paraduodenal hernia we also add another case.

*Symptomatology and Diagnosis*—The symptoms of paraduodenal hernia

12  
14434



FIG. 1—Plate after operation showing similar deformity, but filling of jejunum with barium

are vague and a correct interpretation of the physical findings is difficult. This well explains the fact that a correct diagnosis was not made in any among the total thirty-one cases of right paraduodenal hernia, and that among ninety-one cases of left paraduodenal hernia cited by Píkin<sup>12</sup> only three correct diagnoses were made.

The symptoms are those of chronic or acute intestinal obstruction. In the chronic cases, however, the patient complains of feelings of distress which are quite unlike the ordinary symptoms of an intestinal disorder. Distention,

nausea, vomiting, belching and constipation are common, but the general condition of the patient may remain unimpaired for a long period of time. Acute cases are marked by the usual symptomatology presented in cases of acute intestinal obstruction due to other causes (volvulus or intussusception).

Upon physical examination a mass is frequently palpable. This is globular and cystic in character, and usually situated in the right lower quadrant. Upon auscultation a gurgling sound is audible over the tumor while percussion yields a sonorous, tympanitic note. Dilation of the veins on the anterior abdominal wall, or enlarged hemorrhoidal vessels, may be present, these being due to pressure on the inferior mesenteric vein. There may be visible peristalsis. X-ray examination is of little aid in the diagnosis as the hazy outlines and deformities are difficult to interpret. The condition is usually identified only at operation or necropsy.

*Treatment*—Surgical intervention is the only line of treatment indicated in these cases. In reducing the hernia, care must be exercised to avoid injuring vessels in the anterior margin of the fossa. This applies especially to right paraduodenal hernia in which the superior mesenteric artery is present in the anterior superior margin of the fossa, and also to left paraduodenal hernia in which the inferior mesenteric vein is in such close proximity to the anterior margin. The presence of these vessels may make it impossible to enlarge the neck of the sac by incision in which case careful stretching with the fingers may enlarge it sufficiently to facilitate the return of the intestines to their normal position. Sometimes the presence of numerous dense adhesions may prevent the reduction of the hernia. In such a case the neck of the sac should be enlarged as much as possible to prevent strangulation of the intestines and the resultant development of acute obstruction. These complications must be governed by the condition of the patient and the judgment of the surgeon. After the contents of the sac have been reduced the sac should be closed by ligature preferably distal to the blood-vessels, thereby avoiding injury to the latter.

Short<sup>22</sup> and Philips<sup>16</sup> report a series of twenty-eight cases of left paraduodenal hernia. Among seventeen cases which were operated upon, an incomplete operation was performed in one, and of the remaining sixteen cases, thirteen were cured and three died. Among twelve cases of right paraduodenal hernia two cases were cured and ten died. These figures show that the surgical treatment of these herniæ, of right paraduodenal hernia in particular, is hazardous, and great care must be exercised in reducing them.

#### SUMMARY

An investigation of the literature shows that the incidence of retroperitoneal hernia is relatively rare, and that the majority of the reported cases are of the paraduodenal type. The literature includes reports of thirty cases of right and 100 of left paraduodenal hernia, to each of which we add one more. The diagnosis is rarely made before operation. Surgical intervention is neces-

## RETROPERITONEAL HERNIA

sary but the operation is hazardous. The vessels in close proximity to the margin of the fossa must be avoided. If the hernia can be reduced and a satisfactory ligation of the sac can be made, complete recovery should follow.

### BIBLIOGRAPHY

- <sup>1</sup> Andrews, E. Duodenal Hernia—a Misnomer. *Surg, Gynec and Obst*, 1923, vol xxxvii, pp 740-750.
- <sup>2</sup> Bramlett, W. P., and Ashhurst, A. P. C. Strangulated Retroperitoneal Hernia into the Paraduodenal Fossa, Operation, Death on the Ninth Day. *Am J M Sc*, 1917, vol cliii, pp 641-650.
- <sup>3</sup> Davis, L. A Case of Strangulated Retroperitoneal Hernia of the Small Intestine into the Paraduodenal Fossa. *Bost M and S J*, 1914, vol clxx, pp 272-274.
- <sup>4</sup> Dayton, A. B. Left Duodenal Hernia, Report of a Case. *Johns Hopkins Hosp Rep*, 1919, vol xviii, pp 319-322.
- Desjardins, A. U. Left Paraduodenal Hernia. *ANNALS OF SURGERY*, 1918, vol lxvii, pp 195-201.
- <sup>5</sup> Fionk, C. E. Strangulated Retroperitoneal Hernia. *Mil Surgeon*, 1921, vol xlix, p 463.
- <sup>6</sup> Grad, H. Retroperitoneal Hernia in the Duodeno-jejunal Fossa. *Am J Obst*, 1918, vol lxxvii, pp 102-105.
- <sup>7</sup> Hallock, K. Presentation of a Specimen of Duodenojejunal Hernia. *Surg, Gynec and Obst*, 1918, vol xxvi, p 473.
- <sup>8</sup> Kohlmann, J. Ueber Retroperitonealhernen. Ein Fall von Hernia retroperitonealis totalis accreta. Leipzig, 1913.
- <sup>9</sup> Morton, J. J. Atresia of the Duodenum and Right Internal Hernia. *Am J Dis Child*, 1923, vol xxv, pp 371-378.
- <sup>10</sup> Moynihan, B. G. A., and Dobson, J. F. Retroperitoneal Hernia (Delivered as the Atter and Gale lectures in 1897). London, 1906.
- <sup>11</sup> Nagel, G. W. Right Paraduodenal Hernia. *J A M A*, 1923, vol lxxxii, pp 907-912.
- <sup>12</sup> Nixon, P. I. Retroperitoneal Hernia into the Duodenal Fossæ. *ANNALS OF SURGERY*, 1917, vol lvi, pp 456-461.
- <sup>13</sup> Novak, E., and Sussman, A. A. Right Paraduodenal Hernia. *J A M A*, 1924, vol lxxxiii, pp 1664-1667.
- <sup>14</sup> Nuzum, F., and Nuzum, J. Two Unusual Hernias, One Intersigmoid, the Other into the Paraduodenal Pouch of Landzert. *Tr Chicago Path Soc*, 1914-15, vol ix, pp 191-207.
- <sup>15</sup> Philips, R. S. Paraduodenal Hernia, Description of a Case and Summary of the Literature to Date. *Bull Ayer Clin Lab Penn Hosp*, 1922, No 7, pp 89-104.
- <sup>16</sup> Pidcock, B. H. Intestinal Obstruction. *Brit M J*, 1924, vol i, pp 369-370.
- <sup>17</sup> Prentiss, C. W., and Arey, L. B. A Laboratory Manual and Text-book of Embryology, Phila., 1920.
- <sup>18</sup> Primrose, A. Retroperitoneal Hernia Due to an Aberrant Middle Colic Artery. *J A M A*, 1914, vol lxiii, pp 842-845.
- <sup>19</sup> Pingle, J. H. Report of a Case of Hernia into the Paraduodenal Fossa. *Glasgow M J*, 1916, vol lxxvii, pp 65-72.
- <sup>20</sup> Scheele, K. Beiträge zur Diagnostik der Hernia duodenojejunalis. *Zentralbl f Chir*, 1920, vol xlviii, pp 188-190.
- <sup>21</sup> Short, A. Rendle. A Case of Retroperitoneal Hernia Cured by Operation, with a Report of the Literature of the Subject. *Brit J Surg*, 1915, vol iii, pp 48-58.
- <sup>22</sup> Short, A. Rendle. On Retroperitoneal Hernia, with a Report on the Literature. *Brit J Surg*, 1925, vol xiii, pp 456-465.
- <sup>23</sup> Wallace, W. L., and Allen, I. S. Intra-peritoneal Hernia. A Case. *Buffalo M J*, 1911, vol lvi, pp 300-303.

# OBSERVATIONS ON THE HISTOLOGIC AND PATHOLOGIC ANATOMY OF THE HEPATIC, CYSTIC, AND COMMON BILE DUCTS<sup>\*</sup>

By VERNE G. BURDEN, M.D.

OF ROCHESTER, MINN.

FELLOW IN SURGERY THE MAYO FOUNDATION

THE gall-bladder is looked on as the most important part of the extra-hepatic biliary passages. An enormous amount of experimental and clinical data have accumulated concerning it. Its susceptibility to disease has made it prominent from a surgical standpoint. The effects of its removal especially those of a mechanical nature, have received attention probably because its apparent and most easily understood function is mechanical. Much less attention has been paid to the extrahepatic bile ducts, and one can search in vain the standard text-books of anatomy for a detailed description of them, although their gross appearance and anatomic relations are well known. The constantly increasing frequency of operations for removal of diseased gall-bladders and the many more instances of untreated disease of the biliary tract serve to emphasize the importance of the ducts. In fact the gall-bladder is almost insignificant when compared with the essential nature of the hepatic and common ducts.

According to Heister the liver begins as a single evagination from the gut tube which quickly bifurcates into the anlagen of the right and left lobes. It grows between the layers of the ventral mesentery into the septum transversum and the liver ridge. The latter forms the connective-tissue part of the liver but the hepatic cells and the epithelial cells of the ducts come from the original evagination of the gut. The hollow stalk by which connection is maintained with the gut forms the common duct. That the original diverticulum is single is the opinion of His, Kolliker, Heitwig, Minot, and Pierson. The gall-bladder takes origin as an outpouching of this diverticulum. It should be noted that the extrahepatic bile ducts have a common origin with the liver and the gall-bladder. In this respect they are different from the urinary system, in which the ureter, pelvis of the kidney, and collecting tubules do not take origin from the same anlage as the parenchyma of the kidney, and they serve merely to carry off the excretory products of the kidney.

## REVIEW OF LITERATURE ON THE BILE DUCTS

To obtain any idea of the histologic structure of the bile ducts one must consult books which have long since been swept by in the current of medical literature and are almost forgotten. The German anatomist Theile, in 1844 described certain glands which he found in the walls of the bile ducts. He examined specimens from the pig, the sheep,

---

\* Thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfilment of the requirements for the degree of Master of Science in Surgery March, 1925

## ANATOMY OF THE BILE DUCTS

the horse, and from man. By injecting the ducts with cinnabar and oil of turpentine he was able to distend the glands so that they appeared on the surface as minute round clusters. He noted that in the pig, the sheep and the horse the glands of the bile duct are very similar, they are numerous, and open into the cavity of the duct on all sides. In man however, they are entirely different. In the large as well as in the small duct, which could be opened with scissors, he observed two opposite rows of openings crowded very closely together, but the glands were not so numerous as in the horse, the pig and the sheep. In general they consisted of a large duct with short twists. On the periphery of the duct there were alternating small caecal diverticula and short-stalked clusters. He compared them with the meibomian glands and said that the branches formed an anastomosing network in the wall of the duct.

Kichinan was perhaps the first to direct attention to the many small pouches or parietal sacculi which project out from the lumen of the duct.

Beale, in 1856 and again in 1889, published his views on the bile ducts. He said that in man the openings of the sacculi form two rows on opposite sides of the duct. The greater number however, are openings not of sacculi but of small irregular tubes which run obliquely in the coats of the ducts and anastomose with each other. The vasa aberrantia are irregular ducts with

caecal pouches and are most numerous in the transverse fissure of the liver. They are probably altered secreting tubes which at one time formed a part of the secretory structure of the liver. He did not believe that the glands of the ducts secrete mucus, because the bile of the rabbit in which the sacculi are almost absent contains as much mucus as that of the pig in which animal they are very numerous. He looked on the parietal sacculi as diverticuli in which the bile might be temporarily retained and inspissated, and therefore considered them little gall-bladders appended to the ducts.

Keibel and Mall stated that the embryologic development of the glands of the ducts had not been studied. They are considered to be epithelial pockets rather than mucous glands.

Ross in 1863 said that the glands are most numerous in the hepatic duct rarer

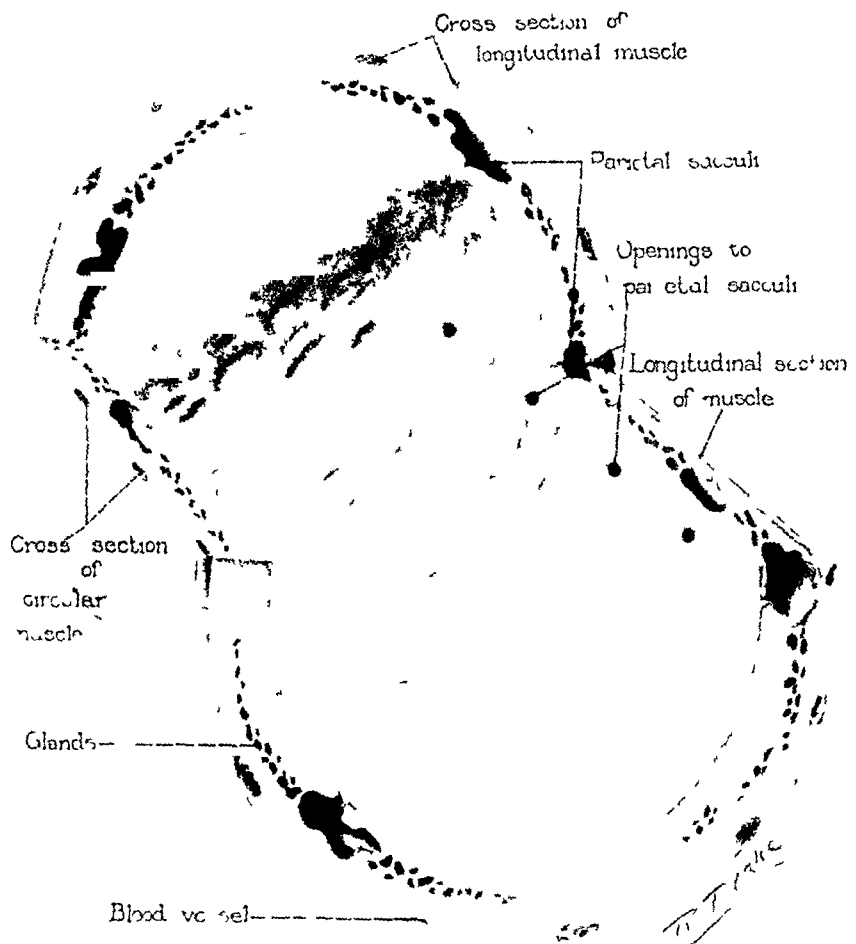


FIG. 1.—Reconstruction of the common duct showing the typical appearance of the mucous membrane, the parietal glands with their ampulla-like openings arranged in four rows and the isolated bundles of circular and longitudinal muscle.



in the upper part of the common duct and in the lower cystic duct, and absent from the lower portion of the common duct. The largest are branched tubes with rounded terminations and the small ones are simply pockets. They are less developed in children than in adults.

The views of Beale have been recently revived by Sweet, who has brought forth experimental data to support his contentions. He noted that after removal of the gall-bladder in the dog there was an immediate rise in total blood cholesterol, which after a period of forty days returned to the normal level. He observed that the parietal sacculi which in the normal dog appear flattened, became elongated and hypertrophied after the

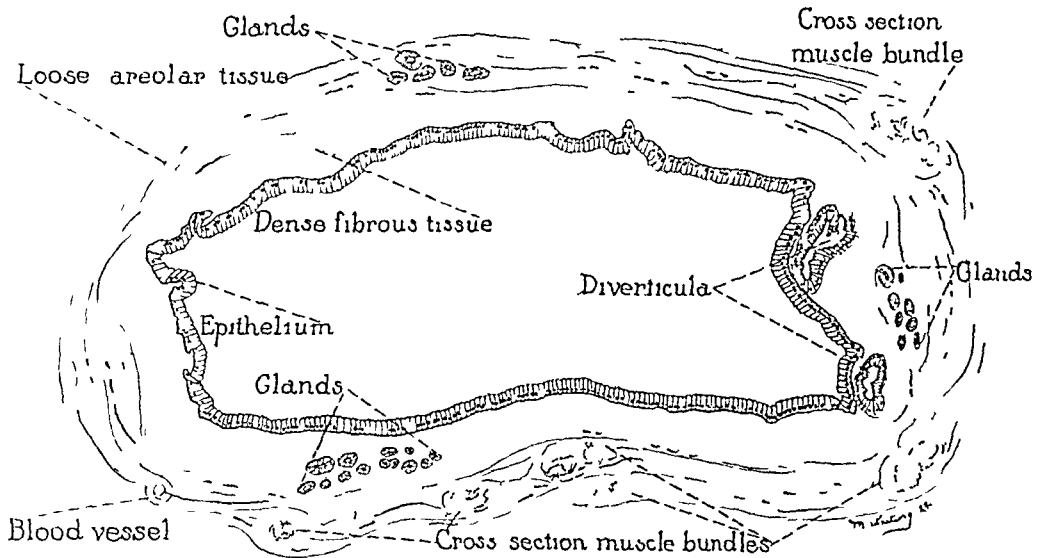


FIG 2 —Cross section of a bile duct showing the position and arrangement of the various structures found in the wall

operation, coincident with the return of the blood cholesterol to the normal level. He believes that the numerous little gall-bladders appended to the ducts not only take over the function of the removed large gall-bladder, but also that pathologic processes which affect one extend to the other.

There is much in Sweet's conclusions to which exception might be taken. For instance, Judd and Mann have shown by experiments on dogs that the common duct dilates after cholecystectomy and that this dilatation is dependent on the intactness of the sphincter of Oddi. The enlargement of the parietal sacculi may be only a part of this mechanical dilatation. It has never been demonstrated that the parietal sacculi contain bile either before or after cholecystectomy.

In other words, in the human subject the walls of the bile ducts are richly supplied with epithelium-lined evaginations. These structures are variously spoken of as diverticula, parietal sacculi, and glands.

Another structure of the ducts which has received attention is the musculature. In 1888, Oddi described a sphincteric apparatus at the termination of the common duct which he believed was maintained in a state of tonic contraction by a nervous mechanism in the duodenum. My study did not include the sphincter of Oddi, and therefore this structure will not be further discussed. Regarding the musculature of the ducts themselves, there are conflicting observations. Beale says that in man there is no evidence of a distinct muscular coat. Matsumo concludes from his study that the common duct has a well-developed musculature only at the lower end. Muscle occurs in the duct above but is very irregular. He says that the common duct is a tube of connective tissue with a strong sphincter muscle at its mouth.

## ANATOMY OF THE BILE DUCTS

Hendrickson, in 1898, in a study of the musculature of the entire extrahepatic biliary system in man, found that longitudinal sections of the common duct revealed only a small amount of muscle. The fibres were longitudinal, diagonal, and transverse, and separated by much connective tissue.

Aschoff says "All these distal bile passages (distal cystic duct, hepatic and common ducts) have practically no smooth muscle, being built from only connective tissue and elastic fibres, and are very rich in specific glands."

Aschoff's statement that the cystic duct proper begins at the termination of the true neck of the gall-bladder and does not contain the folds of Heister but resembles in structure the hepatic and common ducts is accepted. In any subsequent reference to the cystic duct the distal portion will be understood. The various theories regarding the variations of position and the function and dysfunction of the cystic duct in relation to the formation of gall-stones, as well as the question of a sphincter in this region, are not included in this study.

The physiology of the bile ducts is indeed very incomplete and mostly theoretical. Holmes believed that the glands of the ducts secrete mucus and Robinson says that



FIG. 3.—Cross-section of muscle bundles in the wall of the common duct (X 60)

the glands of the cystic duct secrete fluid and bile salts. It was the opinion of Beale that the glands of the ducts do not form mucus but serve, as the gall-bladder does, to concentrate the bile. Sweet has shown that these glands in the dog hypertrophy after cholecystectomy, but on the evidence that he submits I cannot concur in his deduction that the glands take over the function of the excised gall-bladder. Rous and McMaster<sup>20</sup> conclude from their experiments that the gall-bladder and ducts exert opposite influences on the bile. The ducts do not concentrate and thicken it with mucus as does the gall-bladder, but dilute it slightly with a thin secretion of their own which is colorless and devoid of cholates and cholesterol. They do not state whether the secretion is a product of the glands of the ducts or of the lining epithelium. When the obstructed duct system was connected with the gall-bladder they found that the ducts, as well as the bladder, were filled with thick concentrated bile. Apparently these authors take it for granted that the thick bile in the ducts becomes concentrated in the gall-bladder and then passes out into the ducts.

Rost found dilatation of the ducts in all of his animals after cholecystectomy and divided them into two groups. In one group the duct was dilated and had a long functioning sphincteral part; the animal was continent for bile and the function of the sphincter like that in animals with a gall-bladder. In the other group the ducts were only slightly dilated, the sphincteric part short, and the animals not continent. From

the examination of necropsy cases he concluded that absence of gall-bladder function alone was not sufficient to lead to compensatory dilatation of the ducts, nor was dilatation of the ducts in the presence of an atrophied gall-bladder due to the absence of the bladder's function

Klee and Klupfel noted, as did Rost, that after cholecystectomy some dogs became continent and others incontinent, and that in the continent dogs the bile was thick like gall-bladder bile, whereas in the incontinent dogs it was thin and watery

Kausch says that three factors enter into the nature and condition of the bile secretion from the liver, secretion from the bile ducts, and resorption from the bile ducts

It is apparently the unanimous opinion that the bile ducts have a secretion of their own. It is not specifically stated that it is a product of the glands of the ducts. Regarding the question of the resorption of fluid from the bile by the ducts as it occurs in the gall-bladder,<sup>21</sup> opinions are divided.

That the muscle tissue along the ducts plays a part in their activities seems to have been demonstrated by Westphal who found that slight electric and

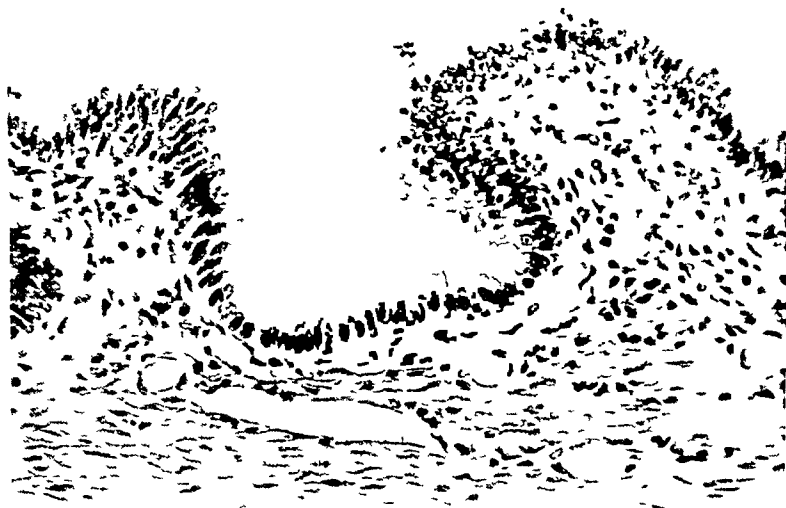


FIG. 4.—One of the numerous depressions on the interior of the duct with adjacent folds of mucous membrane (X 120)

pharmacologic stimulation of the vagus produced contraction of the gall-bladder and dilatation of the upper and middle portions of the common duct

The present study was undertaken to determine the histologic structure of the extrahepatic bile ducts not including the sphincter of Oddi and to determine the nature of the pathologic processes that occur in the ducts. Only the ducts of man were studied.

*Method of Study*—Specimens were obtained from one hundred routine necropsies, regardless of the ages of the subjects or the causes of death. In each case one or more specimens were taken from the hepatic, cystic, and common ducts and placed in formalin solution. The specimens were obtained as soon as possible after death. In the case of the common duct only sections from the supraduodenal portion were studied. Most of the specimens were examined both in the gross and under the dissecting microscope. Microscopic sections were then cut, some longitudinal and others transverse, and stained with hæmatoxylin and eosin. Some sections were stained for elastic fibres. Serial sections were made of a number of specimens.

## ANATOMY OF THE BILE DUCTS

*Results of Study*—Most of the ducts were normal, but in specimens from forty cases there were pathologic changes. The structure of the ducts did not vary with the ages of the subjects: the youngest was eleven and the oldest seventy-five years. According to my observations the hepatic, cystic and common ducts have essentially the same histologic appearance. Therefore it seems best to combine my collective notes into a description of a normal bile duct and then to describe the pathologic changes.

When the duct is laid open the internal surface presents a characteristic appearance and at first seems to be reticulated, but on closer inspection and under the dissecting microscope it is seen to be covered by minute pits or shallow depressions, some of which contain plugs of mucus (Fig 1). The purpose of these pits is, apparently, to increase the surface area of the interior of the ducts. The appearance of the pits in ducts which have dilated because of obstruction will be described under pathologic anatomy.

Cross-sections of the duct show that the lining is covered with a layer of tall columnar epithelium. The nucleus of the cell is large, vesicular, well-stained and situated at the base of the cell. The epithelium is similar to that which covers the rugæ of the gall-bladder. The epithelial layer was found intact in comparatively few specimens, and in some instances it had disappeared within an hour after death. Its loss has been attributed to the action of the bile. During life the epithelium readily regenerates to replace any defects in its continuity. Horsley



FIG 5.—Portion of a cross-section of a bile duct showing folds of mucous membrane and a typical so-called parietal saccule (X 60)

showed in an experimental reconstruction of the common duct that the new channel formed from transplanted tissue is quickly lined by epithelium which grows into it from the edges of the normal duct, but the reconstructed duct later becomes almost completely obliterated in spite of the presence of lining epithelium. The process of fibrous obliteration takes place in the connective-tissue layer of the duct. This layer is found just beneath the lining epithelium and contains considerable elastic tissue, as was shown by special stain. The connective-tissue layer is thick and compact, and there can be no question but that it is the chief strength of the wall of the duct. The outer coat of the duct is composed of a loose layer of areolar connective tissue in which are found blood-vessels, lymphatics, and muscle (Fig 2). I did not make special efforts to identify nerve tissue.

In spite of the opinions of others relative to the rarity and even absence of muscle tissue in the ducts, my observations showed that the bile ducts of the human subject are supplied with a well-developed musculature. It was almost constantly present in all specimens and was particularly evident in the cross-sections. Serial sections demonstrated

its presence along the course of the duct. The muscles are situated in the outermost layer of the wall and are made up of good-sized, isolated, oval bundles of unstriated fibres (Fig 3). There are longitudinal and circular bundles, the former being the larger and better developed. A cross-section will usually reveal three or four large round bundles about equidistant in the periphery of the duct and separated by connective tissue which may contain several smaller bundles. I have not been able to find a description of peristalsis in the human bile duct, but from the anatomic standpoint it is possible, as it is seen in the ureter.

It should be pointed out that the majority of the pits which appear on the internal surface of the duct are not the openings of glands, but are shallow epithelium-lined

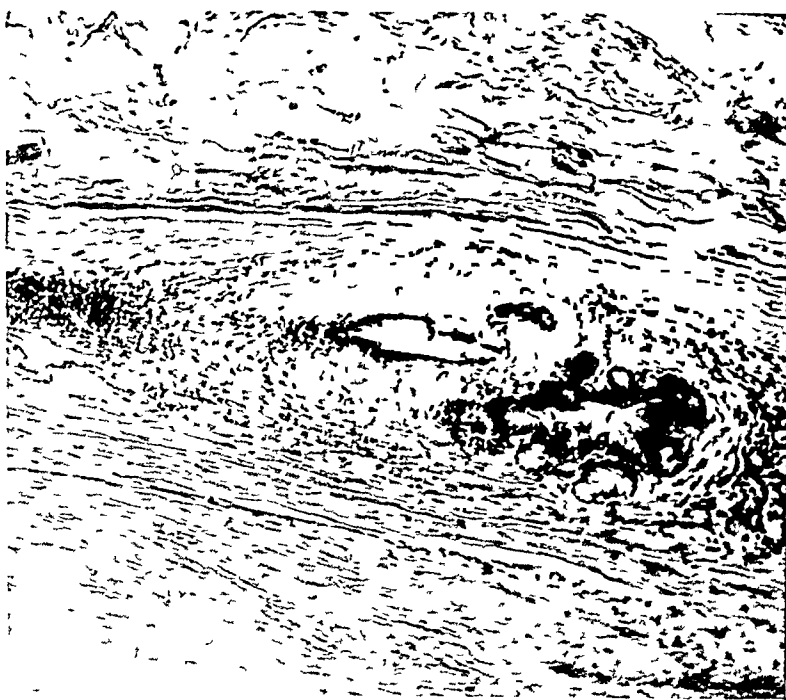


FIG 6 —Nest of glands surrounded by marked inflammatory changes (X 120)

depressions between folds of mucous membrane (Fig 4). Occasionally these depressions take on the appearance of pouches (Fig 5). However, after numerous microscopic sections have been studied, and the development of structures as brought out in serial sections of the duct has been observed it is evident that besides the pits there are deep sacculi or diverticula which communicate by narrow openings with the lumen of the duct. These diverticula occur with definite regularity and seem to be arranged in four equidistant rows around the circumference of the duct (Fig 1). Emptying into the sacculi are numerous glands which ramify in the wall of the duct, chiefly in longitudinal and circular directions, and seem to form almost a complete glandular layer around the duct. Near the sacculi the glands seem to be simple tubes but near the outer wall of the duct, where they are most numerous, they assume more the character of mucous glands and the acini are usually arranged in nests. In contrast to the frequent absence of the lining epithelium of the duct, caused by the action of the bile after death, the epithelium of the sacculi, tubes and glands are invariably intact. This observation helps to support the belief that the sacculi and glands do not retain bile. When their course is traced through serial sections of the duct, they appear to originate in acini in the outer wall of the duct from which tortuous tubes course through the walls to empty in common with other tubes into an ampulla-like opening which in turn communicates with the lumen of the duct. From the structure and arrangement of the diverticula and glands, it seems just as impossible for bile to be retained in them, as it would be for the contents of the duodenum to be retained and resorbed in Brunner's glands. In other words, the current is from the glands into the duct.

There are many variations in the appearance of the glands in apparently normal ducts. They are usually well developed and made up of cells similar to the lining epithelium of

## ANATOMY OF THE BILE DUCTS

the duct. Sometimes they seem to be almost atrophic and the cells small and flat. Glands were present in all specimens of ducts examined.

An accidental finding was the presence in several specimens of accessory pancreatic tissue in the wall of the common duct.

### PATHOLOGIC ANATOMY OF THE BILE DUCTS

In a search through the text-books and recent literature no account of the pathologic anatomy of the ducts was found. The late post-operative complications of cholecystitis in which the common duct is sometimes constricted or completely obliterated by fibrous tissue can be explained only after an understanding of the early changes in the ducts. In discussing the pathologic anatomy of the cystic duct, Else says that the mucous glands may harbor infection and that the secondary changes in the duct following inflammation may cause hydrops and empyema of the gall-bladder.

Disease of the gall-bladder was associated with the diseased ducts in most of the forty cases. No attempt will be made here to correlate the histologic and clinical significance of the lesions in the

ducts, but merely to describe the changes as they appeared in the specimens. The epithelium is very delicate and is usually absent in post-mortem specimens but not as a result of desquamative catarrh.

Inflammation in the duct is usually characterized by lymphocytic infiltration, an increase in connective tissue, and changes in the appearance of the glands. The infiltration by small round cells is sometimes seen just beneath the surface, but more often it is either diffused through the wall of the duct or confined particularly to the area around the glands (Fig 6). In the later stages of inflammation an increase in connective tissue causes the wall to thicken, and the glands are often encased by a dense wall of fibrous tissue. From their characteristic distribution in the wall of the duct, it can be readily understood that inflammation in or around the glands would cause disease of the duct in its entire circumference. The fibrous tissue laid down during the

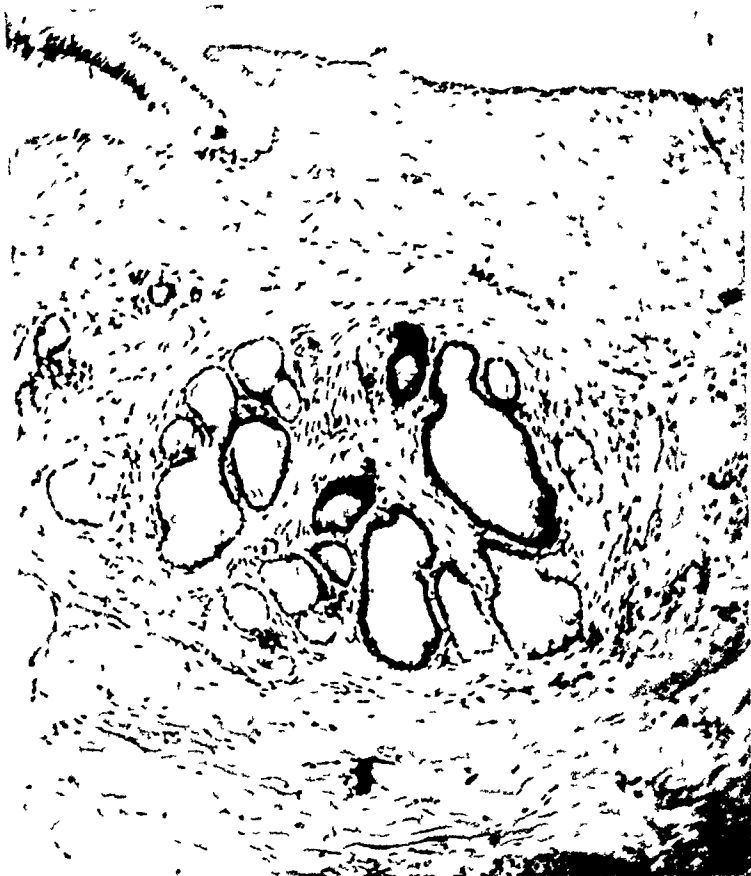


FIG 7 — A group of cystic acini in the wall of the hepatic duct (X 60)

repair of a severe grade of inflammation changes the duct into a rigid melastic tube. In some specimens the wall of the duct is thick and composed almost entirely of fibrous tissue. When the inflammation and fibrosis are localized in a short segment, a stricture of the duct may occur. A more extensive process may be followed by obliteration of a large portion of the duct. The glands, besides being surrounded by a zone of lymphocytes are often dilated and cystic with flattening of their lining cells (Fig 7). Sometimes the glands were small and atrophic as if choked by fibrous tissue.

Even in uncomplicated cholecystitis the hepatic and common ducts show evidence of inflammation, but, as might be expected, the cystic duct shows the most marked changes (Fig 8). The importance of the effects of infection in the wall of the cystic duct should be borne in mind whenever cholecystostomy for cholecystitis is considered as an operation of choice.

Dilatation of the common duct may be caused by obstruction, or it may be the result of infection sufficient to destroy the function of the gall-bladder, or it may follow cholecystectomy. Examination of the duct in the



FIG 8—Cross section of cystic duct from a case of cholecystitis showing folds of mucous membrane like those of the gall bladder and dilatation of the intra-mural glands with round cell infiltration (X 60)

last two conditions may throw some light on the question of compensatory function of the duct. The cystic and common ducts which were markedly dilated as the result of obstruction low in the common duct are shown in Fig 9. The ducts have been laid open and it will be noted that the cystic and common ducts are identical in gross appearance. The pits on the surface of both ducts are plainly evident and it can readily be seen that these pits are mere shallow depressions between folds of mucous membrane and certainly are not dilated nor hypertrophied pouches or parietal sacculi.

#### DETAILED FINDINGS IN PATHOLOGICAL SPECIMENS

CASE I—A woman aged thirty-seven, died following a radical operation for carcinoma of the right breast with glandular involvement. The patient had never been jaundiced. At necropsy the gall-bladder contained forty-two stones and the mucosa had a strawberry appearance. The common duct was markedly dilated and contained

## ANATOMY OF THE BILE DUCTS

seven stones. Sections were made of the ducts. These showed lymphocytic infiltration throughout. Just beneath the surface of the common duct there was a marked inflammation, the glands showed proliferation and were dilated and filled with mucus. The epithelial lining of the duct was intact (Fig. 10). There was no evidence of dilated acini in communication with the lumen of the duct.

**CASE II**—A woman, aged forty-six, gave a history of gall-stone colic. Operation revealed a stone in the common duct and a fistulous opening between the gall-bladder and duodenum. The stone was removed from the duct and a rubber catheter inserted for drainage. The cholecystoduodenal fistula was closed. Death occurred five days after operation. Necropsy revealed a small contracted gall-bladder which was buried in adhesions to the under surface of the liver. There was extreme dilatation of the common duct. Microscopic sections of the duct revealed thick walls with marked lymphocytic infiltration. The glands were cystic.



FIG. 9.—Interior of the cystic and common ducts which were markedly dilated as the result of obstruction.

**CASE III**—A woman, aged sixty-three, came for examination because of repeated attacks of gall-stone colic. Operation revealed acute cholecystitis and stones in the common duct. Cholecystectomy was performed; three stones were removed from the common duct and a rubber catheter inserted into the duct for drainage. The patient died four days after operation. At necropsy a stone was found in one of the larger intrahepatic ducts and also a stone in the common duct at the junction of the cystic duct which had ulcerated through from the cystic duct. The common duct was markedly dilated, and measured 2.5 cm. in circumference. The microscopic

sections of the duct showed inflammatory changes and great proliferation and dilatation of the glands just beneath the lining epithelium.

**CASE IV**—A woman, aged forty-nine, gave a history indicative of cholecystitis. At operation an old empyema of the gall-bladder was found and there were stones in the common duct. Cholecystostomy and choledochostomy were performed. Death occurred five days after operation. Examination of the biliary tract revealed one large and many small stones in the lower end of the common duct just above the ampulla. All the extrahepatic ducts were dilated and the common duct measured 3.5 cm. in circumference. The intrahepatic ducts were not dilated. The microscopic sections showed that the walls were thick, oedematous and infiltrated with lymphocytes. Very few glands were seen.



CASE V—A man, aged seventy-two, came for examination complaining of stomach trouble. He was found to have a carcinoma of the stomach which in the roentgenogram appeared to be operable. The patient died following resection of the stomach. At necropsy stones were found in the gall-bladder and in the common duct. The gall-bladder was small and contracted as a result of chronic infection, and the common duct was markedly dilated and contained stones just above the ampulla. Microscopic examination of the ducts showed that the walls were thick, oedematous, and infiltrated with

round cells. The glands of the ducts were only moderately dilated.

CASE VI—A man, aged sixty-five, gave a history of repeated attacks of severe colic in the right hypochondrium. He was definitely jaundiced and appeared to be very ill, so that it seemed best to keep him under observation for a time until surgical intervention could be more safely undertaken. He became progressively worse and died without having been operated on. Necropsy showed that the gall-bladder had been almost completely destroyed by infection. The extrahepatic bile ducts were markedly dilated and their walls thickened. The ampulla of the common duct was dilated, swollen and oedematous. There was no demonstrable obstruction in the ducts and they were free from stones.



FIG 10.—Section of common duct from a case of stone in the common duct, showing marked proliferation and dilatation of glands just beneath the surface with evidence of inflammatory reaction in the tissues (X 60)

Microscopic sections of the ducts showed that the walls were thickened by fibrous tissue, the glands dilated, and the mucous membrane thrown into folds.

These six typical cases show the presence of inflammatory changes in the ducts in association with infection in the rest of the biliary tract. While the cases illustrate extreme features of biliary disease with active clinical symptoms, many examples could be cited in other cases of ancient and apparently quiescent disease of the gall-bladder, in which less marked but still well-defined pathologic changes appeared in the ducts. It was very exceptional to find the ducts normal in the presence of an obviously diseased gall-bladder. It does not necessarily follow that involvement of the ducts is secondary to that of the gall-bladder, although it is the most plausible explanation. It is possible that the two may be affected simultaneously. The possibility of an ascending infection in the wall of the duct from the duodenum must be also borne in mind, particularly when there is obstruction to the drainage of the ducts by a stone.

## ANATOMY OF THE BILE DUCTS

The gall-bladder, because of its peculiar form and position, is unable to deal adequately with infection, and once infected readily becomes reinfected, because the ability to empty its contents has been seriously impaired, at best it is a diverticulum that drains poorly. On the other hand, the ducts should speedily recover from infection because of their excellent drainage, unless there is obstruction by stone or a focus of infection in another part of the duct system as in the gall-bladder.

A characteristic feature of the inflammatory changes in the ducts is the dilatation of the glands. They become distended with mucus which they pour into the duct. They never contain bile. Irritation of the glands is followed by overproduction of mucus. Others beside these six cases were examined in which the gall-bladder had been rendered functionless by chronic infection. A careful study of the ducts in these cases did not reveal any structural changes that might be considered compensatory for the loss of function of the gall-bladder. The question of compensatory function of the ducts after cholecystectomy can be solved for man only by the gross and microscopic study of the ducts after the removal of a normal gall-bladder. From the evidence before me, which is based on a comparison of normal ducts with those in cases of advanced disease of the gall-bladder, it would seem that the theory is not supported by the facts.

*Discussion*—There can be no doubt that, from the embryologic and anatomic standpoints, the gall-bladder is a part of the duct system. There is also a very evident similarity in minute structure, especially in the type of lining epithelium. Langenbuch, who performed the first cholecystectomy in man in 1882, observed that gall-bladder bile is concentrated, and Rous and McMaster<sup>21</sup> were able to measure this function of the gall-bladder in the dog. It is probably safe to assume that the lining epithelium of the gall-bladder is responsible for its concentrating activity. It is well known that the gall-bladder and ducts secrete mucus. In the case of the former, this function is also probably carried on by the surface epithelium and perhaps aided by the glands of Luschka. In the case of the ducts, mucus is formed mainly in the parietal glands. These similarities between the gall-bladder and ducts, and the observations of Klee and Klupfel that duct bile may be concentrated after cholecystectomy, seem to justify the belief that the ducts are also able to concentrate bile, although this function may be insignificant compared to the greater function of the gall-bladder. White bile occurs in the obstructed ducts from which the gall-bladder has been excluded, probably because the concentrating activity of the ducts, being handicapped by a very limited surface area, cannot keep pace with the excretion of bile from the liver. The residual bile present in the duct after cessation of the flow, disappears through absorption and is replaced by mucus.

The dilatation of the ducts which follows removal of the pressure regulatory function of the gall-bladder, either by disease or by operation, is probably mechanical in origin, because it does not occur when the sphincter of Oddi is not intact. The ducts do not dilate when there is incontinence of the

sphincter which accounts for the relatively normal size of the ducts, sometimes seen with cholecystitis and occasionally after cholecystectomy. The findings in this group indicate that absence of the function of the gall-bladder is not solely responsible for dilatation of the ducts and also that the ducts do not take over the function of the ablated gall-bladder.

#### SUMMARY

The hepatic, cystic (distal part), and common bile ducts are identical in structure. They are lined by a layer of tall columnar epithelium which covers a surface made uneven by numerous shallow depressions. The epithelium rests directly on a thick compact layer of elastic connective tissue which makes up most of the thickness of the wall and on which the tensile strength of the duct is mainly dependent. The outside coat of the duct is composed of a loose layer of areolar tissue in which are found bundles of unstriated muscle, blood-vessels, and lymphatics.

The walls of the ducts are richly supplied with glands which are situated for the most part in the outer coat but the ducts of the glands, coming together from all directions finally empty into ampulla-like openings which are arranged in a regular manner around the duct and communicate with its lumen. There is no evidence of true parietal sacculi or diverticula.

The ducts are provided with a well-developed musculature which is composed of isolated longitudinal and circular bundles situated in the outer layer of the duct and separated from each other by connective tissue. The muscle does not form a compact layer but is arranged as a loose network.

The most frequent pathologic changes in the ducts are those of inflammation. Cholecystitis is nearly always accompanied by infection in the walls of the ducts. The lesions are those of the usual chronic inflammatory type, characterized by lymphocytic infiltration and the production of fibrous tissue. The glands may retain infection and aid in its dissemination through the duct. The glands respond to the irritation by an overproduction of mucus and become dilated and cystic. The process of repair is attended by the formation of fibrous tissue which results in a thick and inelastic tube.

#### BIBLIOGRAPHY

- <sup>1</sup> Aschoff, L. *The Orthology and Pathology of the Extrahepatic Bile Passages*. Lectures on Pathology. New York, P. B. Hoeber, 1924, pp. 181-205.
- <sup>2</sup> Beale, L. S. *On Some Points in the Anatomy of the Liver of Man and Vertebrate Animals*. London, John Churchill, 1856, p. 30.
- <sup>3</sup> Beale, L. S. *Lectures on the Principles and Practice of Medicine*. The Liver. London, J. and A. Churchill, 1889, p. 48.
- <sup>4</sup> Else, J. E. *The Role of the Cystic Duct in Recurring Cholecystitis*. Surg., Gynec. and Obst., 1919, vol. xxviii, pp. 467-471.
- <sup>5</sup> Heisler, J. C. *A Text-book of Embryology*. Philadelphia, W. B. Saunders, 3 ed., 1907, pp. 207-209.
- <sup>6</sup> Hendrickson, W. F. *A Study of the Musculature of the Entire Extra-hepatic Biliary System, Including that of the Duodenal Portion of the Common Bile-duct and of the Sphincter*. Bull. Johns Hopkins Hosp., 1898, vol. ix, pp. 221-232.

## ANATOMY OF THE BILE DUCTS

- <sup>7</sup> Holmes, Bayard The Mucous Glands of the Bile-ducts and Gall-bladder *Lancet-Clinic*, 1911, vol cvi, pp 678-684
- <sup>8</sup> Horsley, J S Reconstruction of the Common Bile-duct *Jour Am Med Assn*, 1918, vol lxxi, pp 1188-1194
- <sup>9</sup> Judd, E S, and Mann, F C The Effect of the Removal of the Gall-bladder An Experimental Study *Surg, Gynec and Obst*, 1917, vol xxiv, pp 437-442
- <sup>10</sup> Kausch, W Der Hydrops des gesamten Gallensystems bei chronischen Choledochus-verschluss und seine Bedeutung für den Chirurgen *Mitt a d Grenzgeb d Med u Chir*, 1911, vol xxiii, pp 138-168
- <sup>11</sup> Keibel, F, and Mall, F P Manual of Human Embryology Philadelphia, J B Lippincott Co, 1912, p 412
- <sup>12</sup> Kiernan Quoted by Beale
- <sup>13</sup> Klee P and Klupfel, O Experimenteller Beitrag zur Funktion der Gallenblase *Mitt a d Grenzgeb d Med u Chir*, 1914, vol xxvii, pp 785-795
- <sup>14</sup> Langenbuch Quoted by Kausch
- <sup>15</sup> Matsuno, Y Ueber die Muskulatur des Choledochus *Arch f path Anat*, 1923, vol ccxlvii, pp 208-215
- <sup>16</sup> Oddi, R Sulla tonicità dello sfintere del coledoco *Arch per le sc med* 1888, vol xii, pp 333-339
- <sup>17</sup> Riess Quoted by Keibel and Mall
- <sup>18</sup> Robinson, B Glands of the Cystic Duct *Medical Age*, 1904, vol xxi, pp 721-726
- <sup>19</sup> Rost, Franz Die funktionelle Bedeutung der Gallenblase Experimentelle und anatomische Untersuchungen nach Cholecystektomie *Mitt a d Grenzgeb d Med u Chir* 1913, vol xxvi, pp 710-770
- Rous, P, and McMaster, P D Physiological Causes for the Varied Character of Stasis Bile *Jour Exper Med*, 1921, vol xxxiv, pp 75-95
- <sup>20</sup> Rous, P, and McMaster, P D The Concentrating Activity of the Gall-bladder *Jour Exper Med*, 1921, vol xxxiv, pp 47-73
- Sweet, J E The Gall-bladder its Past, Present, and Future *Internat Clin*, 1924, vol 1, pp 187-226
- <sup>21</sup> Theile Handwörterbuch der Physiologie mit Rücksicht auf physiologische Pathologie, von Rudolph Wagner Braunschweig, Vieweg und Sohn, 1844, vol ii, pp 349-351
- <sup>22</sup> Westphal, K Muskelfunktion, Nervensystem und Pathologie der Gallenwege II Experimentelle Untersuchungen über die nervöse Beeinflussung der Bewegungsvorgänge der Gallenwege *Ztschr f klin Med*, 1923, vol xcvi, pp 52-94

## SPONTANEOUS RUPTURE OF THE SPLEEN

By H S HANSELL, M D

LT COLONEL MEDICAL CORPS, U S ARMY

OSCAR O—Private Company 'A' 15th Tank Battalion was admitted to the Station Hospital at Fort Benning, Georgia, from command, on the evening of April 25, 1924. He was aged twenty-four years, white, single, born and raised in Alabama, has never been to the tropics. Habits as to alcohol abstemious never drunk, no drug habits smokes pretty steadily.

Family history negative

Past history Had measles in 1915. Has never had any serious illness always well and healthy. No malaria, typhoid, influenza, rheumatism, throat trouble, or other ill health. No indication of stomach disturbance. Was raised in the country and a small town. Worked at home on the farm. Has been in the army four years, all of which time was spent in Georgia or Alabama, with the exception of a few months in Florida. No gunshot wounds or other casualties. Denies venereal history. He is on duty as a cook, with no heavy work.

Present illness Patient states he had finished his duties for the day as a cook and after eating a light supper of bread, a canned pear and some jelly, was standing on the porch, smoking a cigarette, when he was taken with a sharp pain in the upper part of his belly and lower left chest. He felt nauseated and giddy, vomited once. Walked over to his barracks, a few hundred yards away, and laid down on his bunk for a while, felt he was getting worse, so walked to hospital about a quarter of a mile, and was admitted to Medical Service and put to bed. On admission—a well developed young man, age twenty-four years, weight 180 pounds. He complains of acute pain over upper abdomen, more on left and over left side of chest. Respiration is painful. The pain extends into the left shoulder and down his arm and forearm. Says his hand feels numb on the outer side. Feels nauseated. His general condition is one of shock. The skin is pale and clammy from cold perspiration, the mucous membranes pale. Pulse 112 by stethoscope, 58 by wrist. Blood-pressure 80 over 50, heart is negative. No râles or rub heard in chest, which is negative. Temperature 97, respiration 20.

The abdomen is fairly soft practically no distention. There is pain and tenderness on deep pressure over epigastric and splenic areas with slight increase in dullness over latter.

With rest in a heated bed and shock enema of whiskey and coffee, the patient reacted somewhat, became more comfortable, and showed slow but progressive improvement during the next forty-eight hours. Laboratory reports showed urine negative, stools negative for parasites, ova or blood, blood count red cells, 3,900,000, whites 16,200 hemoglobin 70 per cent—Differential small mononuclears 14 large mononuclears 2 polymorphonuclears 84. Blood culture shows no growth and is negative for malaria. On the 27th the count showed 4,000,000, 11,600, and 76.

Wassermann taken at this time was reported later as negative.

X-ray of chest states lungs appear clear, left leaf diaphragm appears slightly elevated.

On the morning of the 28th, the symptoms and physical signs showed a recurrence of pain or pallor, air hunger feeling or giddiness. Some gaseous distention of belly appeared, with dullness in left flank.

The patient was at once transferred to the operating room, with diagnosis of internal hemorrhage probably from ruptured spleen.

Under gas-oxygen anesthesia, a four and one-half inch incision was made over the middle of the left rectus single muscle parallel to its fibres, the lower end extending to a

## SPONTANEOUS RUPTURE OF THE SPLEEN

point about 1 inch below the umbilicus. On opening the peritoneum, a large amount of free and clotted blood was liberated. The spleen was immediately sought and located. On palpation it felt moderately enlarged and extensively lacerated. It was free of adhesions, surrounded by a large blood clot, and easily delivered through the abdominal incision. The vessels and peritoneal ligaments were clamped, ligated, and the spleen removed. The capsule and splenic tissue had been torn through and through in an irregular jagged fashion. Some of the larger blood clots were removed from the abdomen, normal saline solution poured into the belly and left there, and the belly closed in layers.

A transfusion of citrated blood was given on the table, and again later in the ward, together with saline per rectum and intravenously.

Subsequent history shows a fairly smooth and gradual but incomplete recovery. Stitches were removed on the eighth day, wound healed and dry. Patient up in wheelchair, feeling rather peaked, on the fourteenth day, walking about feebly on the twenty-first.

The patient ran a sustained temperature for about six weeks 100 to 102 $\frac{1}{4}$  in the afternoons, 98.6 to 100 in the mornings—at the end of that time the temperature was normal, and remained so except for an occasional 99.

The pulse during the febrile period showed a corresponding excitement, with maximum of 114. For the last week it varied between 72 and 80.

The blood-pressure on the 7th of May was 100 over 60, on the 11th, 115 over 75.

Cultures made from abdominal blood clots showed no growth in 48 hours. Cultures from the blood were sterile on repeated examinations. Examinations for malarial organisms were always negative.

On May 1, three days after operation, patient complained of recurrence of pain in left shoulder and arm—the next day it had disappeared. He has had occasional mild recurrences since then.

Through several weeks there was complaint of pain in the right lower quadrant, and in the left upper belly. There was a tendency toward gaseous abdominal distention and constipation, which required repeated enemata, pituitrin, and various cathartics. He was practically free from these symptoms for ten days preceding his discharge on furlough the 8th of July. At that time he was rather listless in his movements, had a poor color, and said he tired easily on exertion. He had regained much of his original weight. About the end of July, 1924, he returned from sick furlough which he had spent at his home in Andalusia, Ala. He stated that he suffered considerably during his furlough with dull pain and ache almost constantly in abdomen, just to the right of the umbilicus, always more aggravated at night. His appetite was fairly good over this period of time, but his bowels would not move regularly, and it was necessary to resort to laxatives every two or three days. He slept poorly all the while, felt nervous and weak, just as if he could not put one foot before the other.

After about twenty days of his furlough were spent, he decided to return to the hospital for treatment. He was admitted July 27, 1924, and on admission complained of night cough, which caused him pain in the right lower quadrant, and a feeling as if something was being torn up. The pain, apparently, was more confined to McBurney's region at this time (July 30), and the patient was observed for appendicitis for a couple of days on his developing soreness in that region. Blood examination made at that time (July 30, 1924) showed 4,344,000 red, 7,450 white, polymorphonuclears 65 per cent. No malaria found. In a couple of days the soreness just previously mentioned disappeared somewhat. His general condition of malaise, anorexia and mental depression remained unchanged.

On August 15, 1924, in addition to the special diet which the patient had been getting since August 3, fresh beef bone-marrow sandwiches were added. Bid Blauds pills and I Q S Ac. The patient relished the sandwiches, and his mental attitude became somewhat

more cheerful Blood count taken August 21, 1924, showed increase of about 700,000 red cells per cu mm, with 10 per cent increase in hæmoglobin Patient would interest himself in novels and both his mental and physical condition seemed improved

August 25, 1924, patient complained of pain in eyes after reading Examination made showed negative results Since August 25 the patient has been more depressed and has headaches off and on all the time Appetite is quite good but bowels are not regular, and laxatives are necessary He says he doesn't know how he feels Since admission patient has gained three pounds He now weighs one hundred and fifty-eight

Following table shows weekly blood examination and result of G I Series taken August 8, 1924

Result of Gastro-intestinal Series taken on Private Oscar Olmstead and also weekly blood examination

X-ray taken August 8, 1924

The stomach is of the steer horn type and appears atonic It is not freely movable Duodenal cap clearly outlined and fills evenly Peristalsis sluggish six hours Stomach empty head of meal at sigmoid flexure, 24 hours Colon practically free of meal Appendix not visualized Cæcum fairly fixed Barium enema entire colon filled in six minutes, descending colon redundant Sharp angle at splenic flexure Cæcum bulbous and ileocaecal valve is incompetent

Impressions Ileocaecal incompetency, cæcum held immovable by adhesions Appendix pathology probable

7-24-24— 13 700 white 22 Small mon 5 large poly 73

7-30-24— 4 344 000 red 7 450 white Small mon 26 large 9 trans 1, poly 65

8-14-24— 3 576 000 red, 7,880 white, Hemo 80% Small mono, 42, large 6, trans 2 poly 50

8-29-24— 4,208 000 red 9 000 white, Hemo, 85% Small mono, 22 large 10, trans 4, poly 64

8-31-24— 4 230 000 red 7,200 white, Hemo, 90%, Small mono, 29 large 7, trans 2 poly, 62

On September 26, 1924, the patient was transferred to Walter Reed General Hospital for further observation and treatment Upon his admission there he complained of general weakness and nervousness, pain in right lower quadrant and constipation His weight was 157 pounds, and the blood-pressure 100/63 The tonsils showed a chronic follicular tonsillitis and there was some tenderness over MacBurney's point upon deep pressure

The urine and stools and sputum were negative The blood count was as follows

#### *Blood Count*

Red corpuscles	5 150,000
White corpuscles	15,500
Hæmoglobin	90%
Small monos	29
Large monos	1
Eosinophiles	8
Polys	70

The patient's appearance and conduct in the ward were those of a man in mental distress He appeared to take little or no interest in what went on about him He says he feels "down and out," disheartened, and "low in his mind" He complains of pain in region of heart, which extends up into left shoulder, headaches, which have troubled him ever since the operation, and sometimes pain in right lower quadrant He says he is so weak that walking only a short distance makes him short of breath and wears him

## SPONTANEOUS RUPTURE OF THE SPLEEN

out His appetite is not good and he is sleepless and constipated Weight is now 155 pounds, and the blood-pressure, 120/80

Blood counts at intervals of about ten days were as follows

Red corpuscles	3,800,000	4 250,000	4,920,000
White corpuscles	12,500	12,500	12,500
Hæmoglobin	75%	90%	90%
Small monos	32	18	47
Large monos	1	6	3
Eosinophiles	0	0	0
Polys	67	76	50

There was no further change in his condition, and as it was apparent that he would never be fit for duty as an able-bodied soldier, he was discharged on certificate of disability on January 7, 1925

The spleen was sent to the Laboratory of the Surgeon General for pathological report and museum preservation Following is a copy of the report

*Specimen from Spleen*—Received from Station Hospital, Ft Benning, Ga

Received spleen measuring 8 x 9 x 15 cm weighing 375 gms which shows numerous parallel linear fractures which apparently completely cross the organ A small percentage of these show fungating masses which are apparently produced by the mechanics of the spontaneous rupture The pulp of the spleen shows a moderate increase of all connective tissue and a massive increase of the pulp consisting almost entirely of large mononuclear cells, without constant presence of cytoplasm This increase of cells is accompanied by a rare mitotic figure, to be expected in a cellular increase of this kind, yet not suggestive of any malignancy

There are moderate quantities of black pigment mostly contained in large phagocytes and suggestive of an old malaria There is a moderate hyaline degeneration in the subintimal areas of all small blood-vessels There is an extensive epithelioid and round-cell infiltration of a fairly recent and active character of all medium-sized veins Two of these medium-sized veins show a rupture through the most active areas of infiltration This rupture suggests more of a traumatic aspect from occlusion of venous return rather than a degenerative process A tentative count made on blood in the vessels in the spleen indicates a high leucocytosis the increase of which is chiefly due to large mononuclears of a myelocytic character This coupled with the sudden rise in percentage of large mononuclears as noted in the clinical report suggests a careful observation of this case for lymphatic leukæmia

*Summary*—The pigment in this case suggests malaria which is the commonest cause of spontaneous rupture of the spleen The large mononuclear element suggests further observation for lymphatic leukæmia The recent and ancient degenerations in the blood-vessels would necessitate elimination of syphilis in this case The traumatic character of the rupture of the medium-sized veins above mentioned could have been caused by twisting of the vascular pedicle which could have occluded veins without occluding arteries and so produce a mechanical rupture

Medical literature contains many references to rupture of the spleen Excluding the traumatic type, there remains a fairly large number of so-called "spontaneous ruptures" With the exception of a very few cases in the latter group, there has always been some recognized accompanying pathology, such as malaria, typhoid, septicæmia, kala-azar, undetermined fevers, rheumatism, influenza, appendicitis, tuberculous kidney, carcinoma of stomach, dysentery The present case seems to come under the small group of purely



spontaneous ruptures of unrecognized etiology, with no accompanying or complicating diseased condition

Traumatism offers no explanation. There was no blow or violence from without, no muscular strain from within. Moreover, in this case the clinical course leads one to believe that there was a primary incomplete rupture, followed in about forty-eight hours by a complete and widespread tear. As the case was in bed with absolute rest and restricted diet during this interval, traumatism either external or internal, is ruled out. The second rupture can be attributed to the continued action of the unrecognized factor that caused the first rupture.

A congested spleen following a heavy meal does not apply. It had been six hours since an average meal had been eaten, and an hour and a half since a very light one.

The pedicle of the spleen was not twisted at the time of removal. The spleen was in its normal position, though enlarged (3758 m, 8 x 9 x 15 cm). Malaria excluded, so far as the life history and repeated blood examinations can exclude it, although the abundant pigment present in microscopic section is quite suggestive of this condition. There has been no further evidence of an early lymphatic leukæmia. The blood Wassermann was clearly negative.

The literature on splenic ruptures shows the "occasional" appearance of the following conditions: Loss of weight, polyuria, thirst, thyroid enlargement, lymphatic enlargement and bone pains, blood changes, all of which were absent in this case, and pyrexia of several weeks' duration, abdominal pain and tenderness, prostration, constipation, and pain in the left shoulder, all of which were present. The latter symptom calls for special consideration as a diagnostic sign of ruptured spleen with internal hemorrhage. It has been attributed to the association of the fourth cervical nerve with the phrenic. Its presence was noted in one case of Connors and Downer, one of Willis, one of Fauntleroy, three of Metcalfe and Fletcher, and one of Diehl. Blood changes were not entirely absent. The laboratory frequently reported the red cells as fragile and staining poorly, but there was no blood picture suggesting any blood or systemic disease.

#### CONCLUSIONS

- 1 Sharp pain in the left shoulder and arm, occurring in a case showing signs of internal hemorrhage, is quite suggestive of a ruptured spleen.
- 2 Immediate splenectomy with blood transfusions reduces the mortality materially.
- 3 Spontaneous rupture of the spleen may occur in the absence of clinical evidence of associated disease of other organs, in the presence of an apparently sound and able-bodied person.

## FASCIAL BANDS AS SUPPORTS TO RELAXED FACIAL TISSUE

BY CHARLES CONRAD MILLER, M D  
OF CHICAGO, ILL

VARIOUS types of excisions of skin have been made for lifting tissues relaxed by age. In such patients, no deformity from facial paralysis exists, and lifts are made purely for the relief of signs of age. Such lifts, effected by excision of skin only from the temporal region, or from the side of the face in front of the ear, are not adequate to overcome the effects of facial paralysis. In seventh nerve paralysis, other measures must be used to increase effects, although there is no objection to using these technics of skin excision in such cases as adjuncts to other surgical measures.

In 1913, Kirschner (in *Beitrage zur klinischen Chirurgie*, vol lxxxvi, p 5), writing up the present status and future promises of autoplasmic fascial transplants, gave credit to Peyer as the first to use a strip of living fascia for the establishment of a union between the frontal muscle, and the upper lid in ptosis.

After discussing this subject, Kirschner took up the consideration of facial paralysis, due to seventh nerve injuries. He called attention to the difficulty of nerve anastomosis, emphasizing the serious nature of operations involving dissections in the cervical triangles, and objected to these operations as very uncertain. He pointed out that they destroy forever and completely the function of another nerve. Personally, I do not believe that the uncertainty of nerve anastomosis, is as objectionable as the rather long wait for restoration of function after operation.

The destruction of another nerve is not important provided the operator is judicious in his selection for anastomosis. If we eliminate traumatic cases,

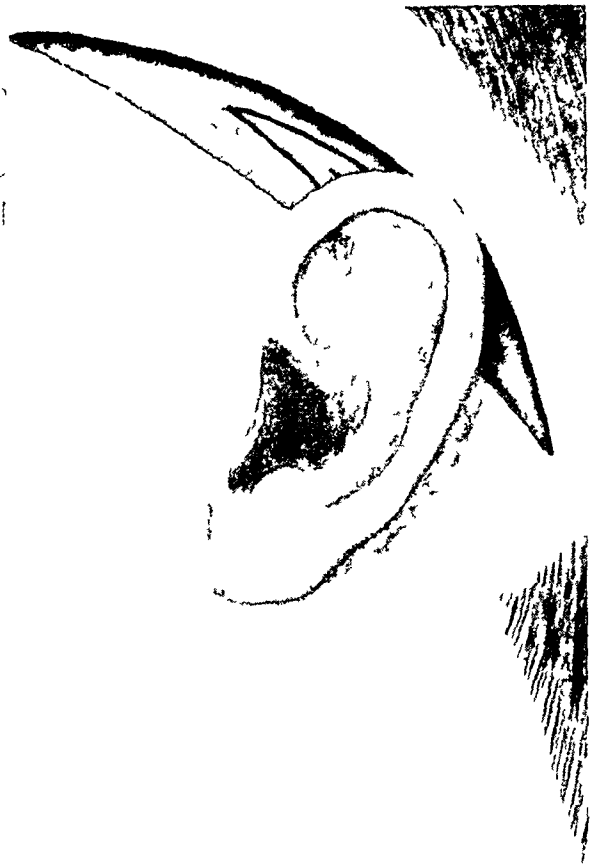


FIG 1.—Excisions may be made entirely in the temporal region or may be extended above or behind the ear. More subcutaneous tissues may be taken than that immediately under the skin excised if the operator elects.

in which extensive sloughing has followed severe injury, and relations of normal tissues are grossly disturbed by cicatrization, nerve anastomosis operations are not very uncertain but are usually successful when the proper time is allowed for regeneration of the nerve after the union has been made.

The second group of methods discussed consisted of muscle transplantation operations. Tomom transplanted half of the sterno-cleido-mastoid muscle into the paralyzed half of the face. Lexer took part of the masseter. Both operations require considerable dissection and after these operations

annoying irremediable associated movements are said to occur.

Lawen attempted to support the lower lip and corner of the mouth by inlaying a piece of bone. Busch used a method of hanging up the sagging corner of the mouth by means of a loop of wire. Friedrich used subcutaneous silk sutures with good result. Momburg reported a large number of cases operated according to Busch's technique. He used aluminum bronze wire.

Since the corner of the mouth often drooped again in spite of the original over-correction he fastened the loop above, not only to the soft parts, but around the zygoma, and took pains to include as large a piece of

FIG. 2.—In women the excision may be extended downward in front of the ear. The strip of tissue should be freed from the skin layers before it is drawn down through the subcutaneous tissues.

tissue as possible at the corner of the mouth. However, even so, the wire cut through partly and destroyed a part of the originally excellent results.

Momburg therefore recommended hardening the tissues at the corners of the mouth by preliminary alcohol injections or inserting a thick wire parallel to the border of the upper lip and letting it heal in, and then at a second operation fastening the looped wire from above, to it. This complicated, decidedly, an otherwise simple operation.

Kirschner said, in substance, "When one recalls the good and lasting results of treating ptosis with strips of fascia, one naturally thinks of using this material here also. It is obvious that an autoplasmic transplanted tissue which becomes intimately united with its new surroundings, can be separated from its new home only with great force, contrary to a metal wire which

## SUPPORTS TO RELAXED FACIAL TISSUE

always remains a foreign body. In addition, a metal wire gradually oxidizes, and breaks, especially here in the cheek where frequent movements take place."

Kirschner recommended the following procedure after general anaesthesia, as he found infiltration oedema objectionable. He made a free incision along the upper border of the zygoma, and passed a properly bent sound behind the zygoma through the soft parts to the corner of the mouth, and close to the corner of the mouth he pushed the point out through a counter-incision. He used a strip of fascia lata about 2 cm wide which he pointed-out should be considerably longer than double the distance between the two skin incisions. This strip, he recommended be drawn behind the zygoma, through the subcutaneous canal, and passed subcutaneously 3 cm medianly, along the upper margin of the lip, and here drawn out through a third incision. From the end of the zygoma, a dressing forceps is pushed subcutaneously towards this third incision, and with it the strip of fascia drawn to the zygoma incision. The two ends of the strip of fascia are here sutured under such tension, that the ring of fascia around the zygoma and soft parts of the upper lip, fold up the corners of the mouth to the degree desired.

Kirschner did not advise undertaking appreciable over-correction, since experience showed him that transplanted strips of fascia did not stretch, and cutting of tissues did not follow.

Burk, in 1916, commenting on the possibilities of autoplasmic uses of fascia lata (*Beitrage zur Klinischen Chirurgie*, vol c, p 427), emphasized the difficulties of operation for facial paralysis when nerve anastomosis was attempted after injuries resulting from gunshot wounds of the bones of the face with extensive destruction of soft parts, such conditions making hypoglossal or accessory nerve anastomosis impossible in many cases. He preferred free transplantation of a strip of fascia for raising the corner of the mouth, to muscle plastics involving the masseter or temporal muscles. Owing to the continual pull upward upon the fascial strip, Burk split the ends of the fascial strip into four pieces, anchoring one end above the angle of the mouth, the other at the angle of the mouth, and the remaining ends in the middle of the upper and lower lips, by which technic, he claimed to secure a

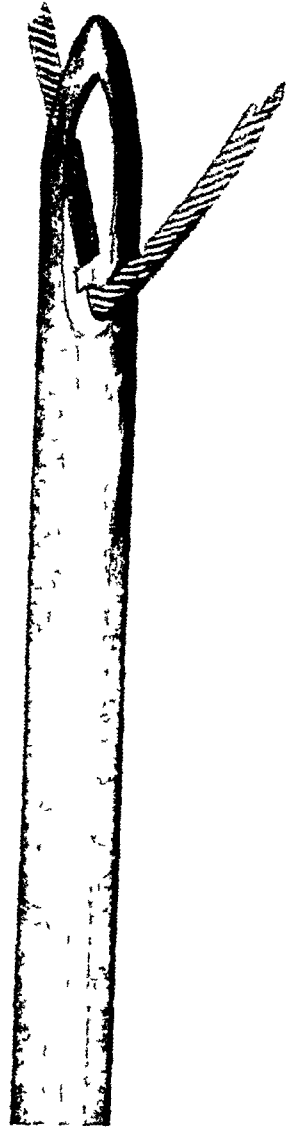


FIG 3 — The large upholsterer's needle is drilled after temper has been drawn and notch formed to hold suture material so that the silk carrier can be drawn down and held while needle is returned to temporal region by pushing the sharpened butt upward through the tissues.

more solid fixation of the strip of fascia, and a better cosmetic result, as he raised not only the corner of the mouth, but the entire left side of the face

Fascial strips are easily secured from the lower outer aspect of the thigh. By subcutaneous dissection long strips may be obtained, through a single short transverse incision. Such fascial strips can of course be passed down from the temporal region, but there is no reason why we should not utilize the dense subcutaneous tissues of the temporal region and not entirely detach strips formed by dissection in this situation. When we go to the temporal

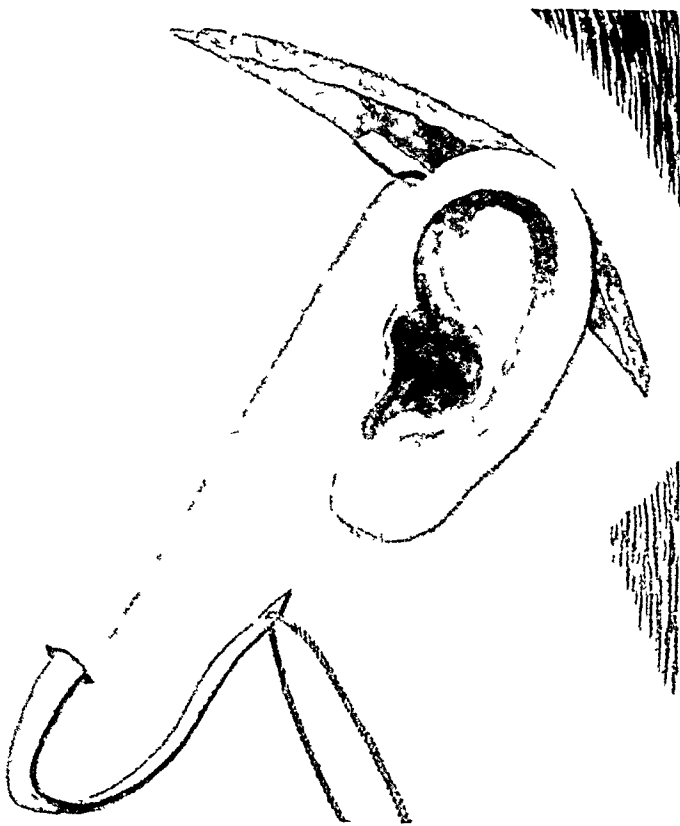


FIG. 4.—The connective tissue strip is drawn down to a point near the angle of the mouth. The free end is then drawn upward through the tissues and anchored in the silk.

region for our connective-tissue strip to effect a facial lift, we should go above the hair-line. Incisions made in the hair, when subsequently sutured, leave scars which do not show. While we know excisions of skin only from the temporal region, or from in front of the ear, will not overcome a facial paralysis deformity, we do know that it can help some. Those of us who have used this method of excision in cases where there is a mere sagging of the tissues from age, know that we can get satisfactory results in certain cases.

It is an advantage therefore to excise some skin from above and in front of the ear. If therefore we make excisions in these regions, and instead of excising skin and subcutaneous tissues, we cut such tissues into the form of a long strip, after removing the outer skin layers of the strip we have a firm dense strip of tissue which can be passed downward toward the corner of the mouth without making an open wound upon a conspicuous part of the face.

The most convenient way to pass such strips downward to the corner of the mouth is with a large upholsterer's needle. A loop of silk is threaded into the eye of the needle, and the eye is so made that the silk loop will be held at the end of the eye nearest the point of the needle. The butt of the needle is sharpened somewhat so that when the needle point has emerged near the corner of the mouth the silk carrier is caught and then before the butt

## SUPPORTS TO RELAXED FACIAL TISSUE

of the needle emerges from the skin it is pushed back upward into the temporal wound. The needle is pushed down from the temporal wound through the deeper tissues. After the point emerges from the angle of the mouth, and the silk carrier has been caught with a hook, the butt of the needle is returned to the temporal wound more superficially. By this procedure, the silk carrier is carried through the tissues in the form of a complete loop.

With the silk loop, the fascial strip is drawn down to the region of the corner of the mouth, and is then drawn upwards to the temporal wound.

No wound is made upon the face except that made by the rather large needle used in carrying the silk down to the region of the corner of the mouth. Such needle punctures heal without leaving appreciable scars.

After the fascia has been drawn down and back to the temporal wound, it should be firmly anchored in place with fine silk.

These silk stitches cause no irritation, are not subject to infection, and insure anchoring the strip permanently.

It is important that the dermal layers be cut away before the strip is buried in the tissues, but we should not expect it to become firmly anchored in connective tissue, the free ends should always be secured with sutures which will not absorb.

After the fascial strip is securely anchored, the skin wound in the temporal region is closed. By such closure the defect in the skin is drawn together and the tissues of the face lifted somewhat.

If one wishes, a subcutaneous fascial strip may be taken from the temporal region or from the auricular region without sacrificing the skin, or one may take a small amount of skin only and by retracting skin edges, cut in the form of a strip, a much larger segment of subcutaneous tissue.

When it is desired to pass one strip to the angle of the mouth, and another just below the malar eminence only, a short strip may be taken by

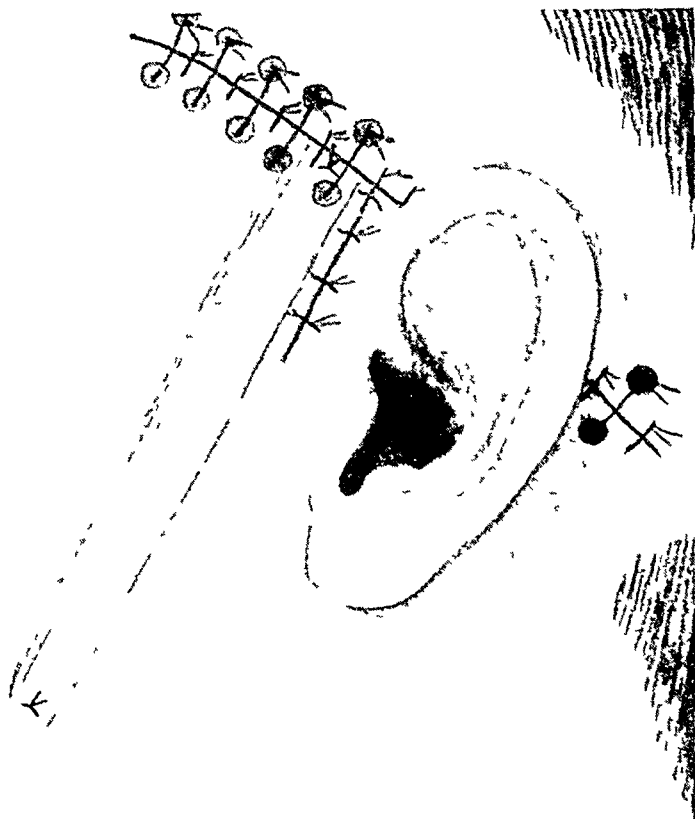


FIG 5—In the completed operation the skin wounds are drawn together where there is much tension the sutures are reinforced in the buttons.

extending the crescentic incision behind the upper part of the ear. Through such skin incision a fascial strip may be cut which can be drawn through the subcutaneous tissues to emerge beneath the malar eminence.

When a strip is drawn through at this point, one should exercise care not to bring the fascial strip too close to the under surface of the skin so that when backward and upward traction is made, a distinct dimple does not form at this point, as a sharp depression will be conspicuous in this situation.

When the fascial strip is drawn down to the region of the mouth, the natural dimple point may be selected as the point of emergence for the needle, in which situation dimpling is unobjectionable.

# COMPENSATORY LENGTHENING OF THE FEMUR IN CHILDREN AFTER FRACTURE

WARREN H. COLE, M.D.

OF ST. LOUIS, MO.

FROM THE DEPARTMENT OF SURGERY, WASHINGTON UNIVERSITY SCHOOL OF MEDICINE, AND  
ST. LOUIS CHILDREN'S HOSPITAL

THREE years ago we<sup>1</sup> reported a series of 31 cases of fracture of the femur in children and emphasized the restitution of the shaft practically to normal, and its compensatory lengthening. A short time previous to this,



FIG. 1.—Case I. Four weeks after oblique fracture upper third.



FIG. 3.—Case II. Three weeks after transverse fracture middle third.

Truesdell<sup>2</sup> reported overgrowth of bone in 5 cases of fracture of the femur. Since then compensatory growth has been observed by several authors. Our first publication included a series of 31 cases. Fifteen more cases have been



observed since then. We were able to follow up and observe only 20 of this total of 46 cases\* for more than one year. Of these 20 cases, 14 presented

no shortening whatever when examined one year or more after fracture. Three presented shortening varying between  $\frac{1}{4}$  inch and  $\frac{3}{4}$  inch, but these patients were seen only slightly more than one year from date of injury. Since it is generally agreed that lengthening takes place as late as two years after injury, it is safe to assume that their shortening will lessen if not entirely disappear within the next year or two. The three remaining patients were observed for two years or more following fracture and still presented  $\frac{1}{4}$  inch to  $\frac{3}{4}$  inch shortening. Two of these patients, both of whom were operated because of delay in proper union when shortening demanded temporary internal splintings, presented femurs with either a marked anterior or lateral bowing. Even in these two patients compensatory growth may have taken place, but was probably counteracted by the bowing deformity of the shaft.

Six of the patients who returned were studied very closely and thorough roentgen ray examinations made.

#### METHOD OF RE-EXAMINATION

David<sup>3</sup> has outlined an accurate method of determining shortening and growth, in an article in which he reports a gradual compensatory growth

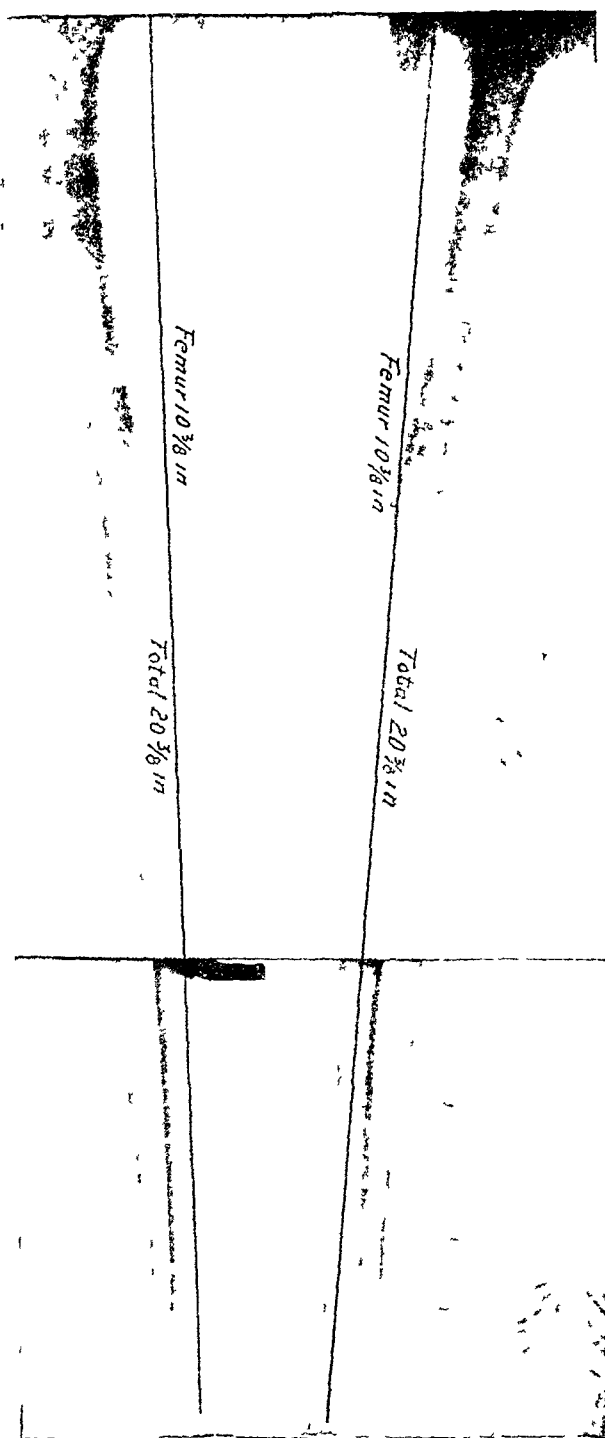


FIG 2—Case I Two years after fracture Measurements reveal no shortening

\* This series was taken from the service of Dr. M. B. Clopton of the St. Louis Children's Hospital, and credit is due him for advice and suggestions.

## COMPENSATORY LENGTHENING OF THE FEMUR

in the majority of cases of fractures of the femur in children. He stresses the need of placing the patient on a hard table with anterior superior spines of the pelvis on the same level and with the heels equidistant from a line running from the umbilicus through the symphysis pubis to the level of the internal malleolus of the tibia when taking measurements of roentgenograms.

To eliminate or detect any source of error in measurements from the X-ray plates, we superimpose a rule with a metal marker at each inch of its length, parallel to the shaft of femur and tibia on each side about two inches above the film† (See Figs 2, 4, and 6). By taking precautions we feel that the comparative measurements of each shaft of the femur on the X-ray film represents a very accurate comparative measurement and distinctly more accurate than measurement between bony landmarks on the child's body.



A very interesting example of over-

FIG 5 —Case III Four weeks after oblique fracture middle third

growth of bone has been observed by Brooks and Lehman<sup>4</sup> in cases of bone involvement by Recklinghausen's Neurofibromatosis.

† If there is any rotation of the pelvis or difference in distance from each shaft to the plate, there will be a discrepancy in the measurement of distance between an equal number of metal markers on the X-ray film on the two sides. Care is also taken when making roentgenograms that a line drawn perpendicularly from the tube to the film is equidistant from the shafts of the two femurs, and also from the rules with metal markers on each side. As would be expected, it was found that the actual measurement between each marker on the end of the film was greater than the distance between them in the central portion of the film,  $11/10$  inches and  $11/16$  inches, respectively. It was found, however, that the distance between 15 markers was exactly equal to the distance between an equal number of markers alongside the other femur directly opposite.

The following patients represent a series which were studied with unusual care in regard to measurements on the roentgenogram. It should be empha-

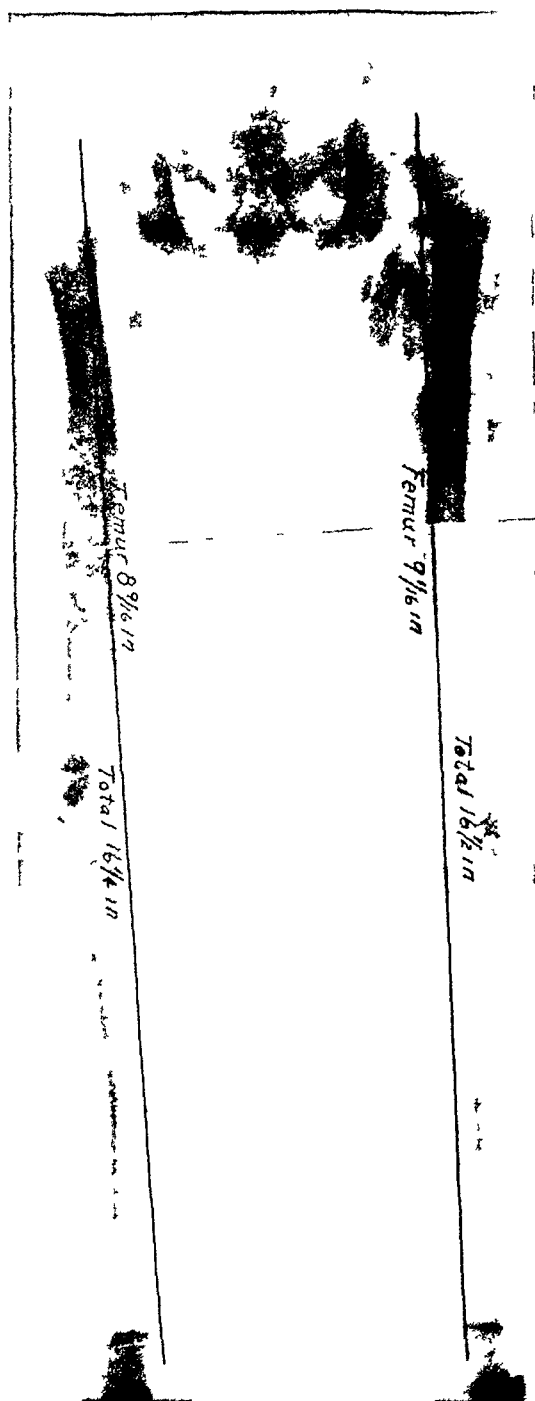


FIG 4—Case II Two years after fracture Shortening of femur was  $\frac{1}{8}$  inch but difference in total length of femur and tibia was only  $\frac{1}{16}$  inch

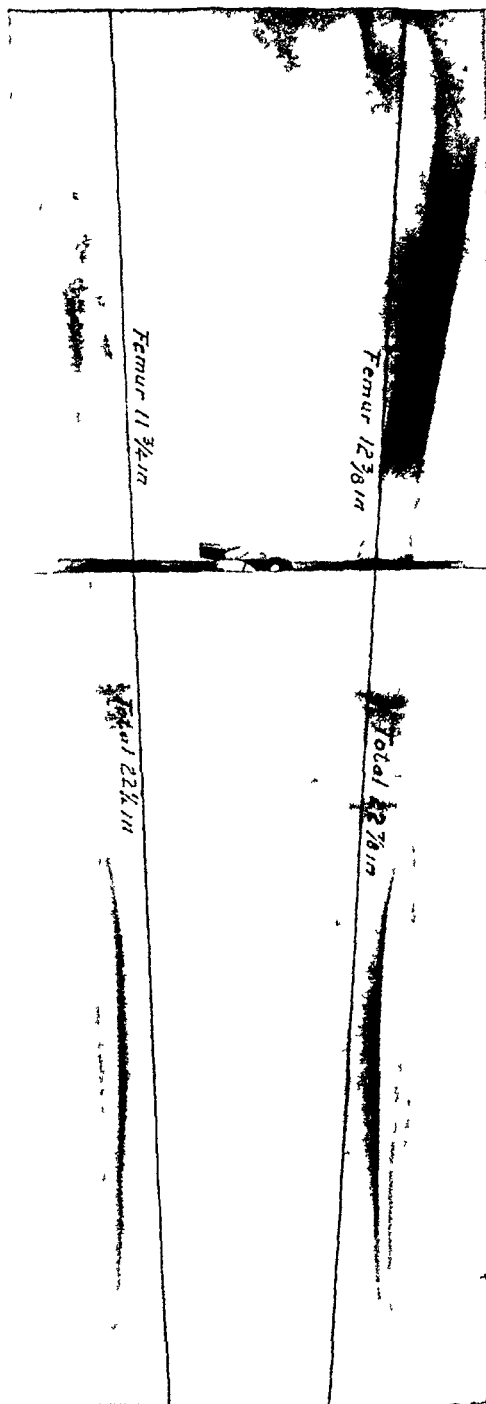


FIG 6—Case III One year after fracture Shortening of shaft of femur found to be  $\frac{5}{8}$  inch but shortening of combined measurement femur and tibia was only  $\frac{3}{8}$  inch

sized that the amount of shortening discovered on the roentgenogram slightly exceeds the actual bone shortening or measurement on the living subject. All

## COMPENSATORY LENGTHENING OF THE FEMUR

of these roentgenograms were taken with the tube at a distance of 40 inches from the film. Assuming the shaft of the bone to be about 2 inches from the film, it can be estimated with the aid of geometry that the measurement on the

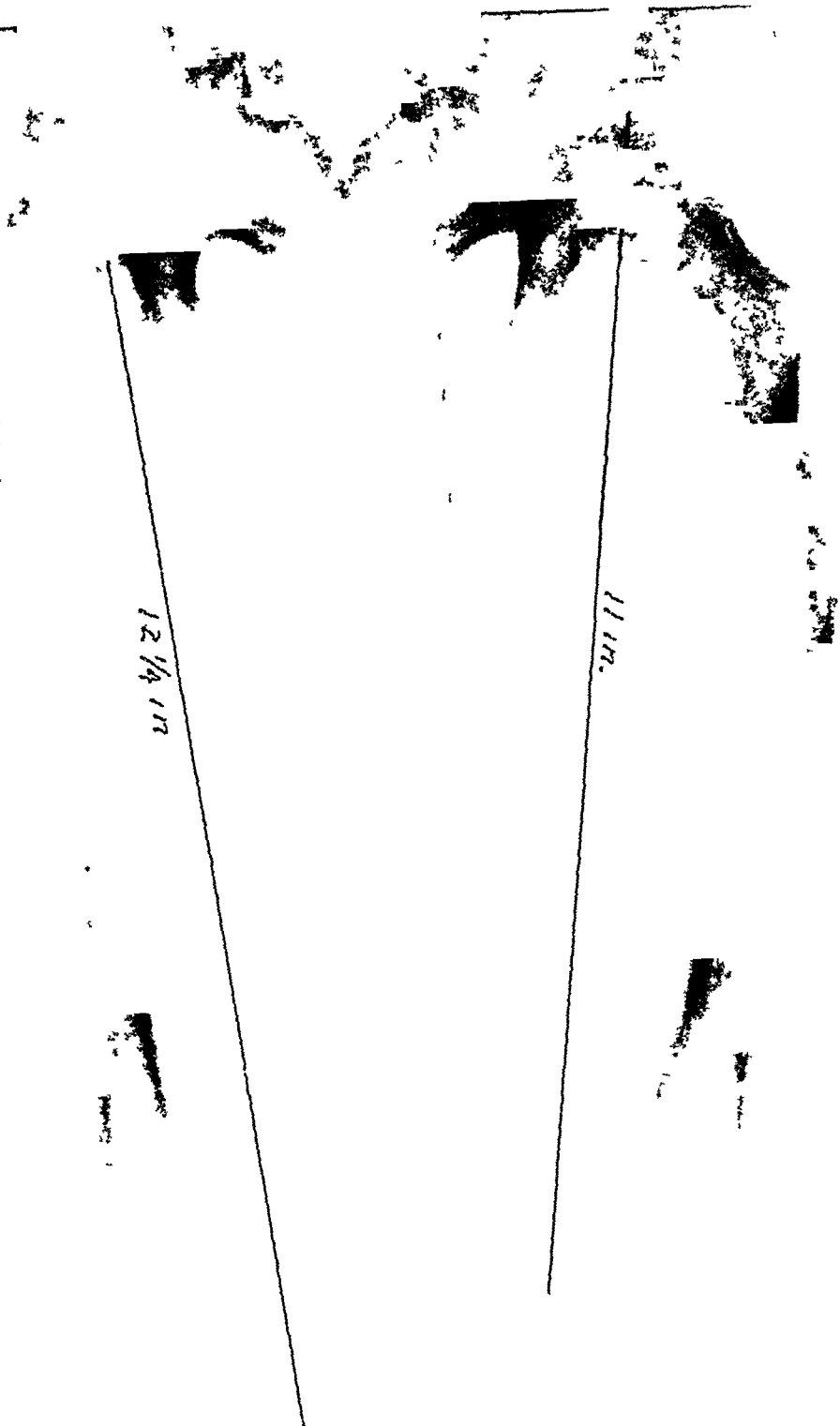


FIG 7—Case IV Three months after oblique fracture upper third. Considerable difficulty in treatment on account of inability to correct the marked overriding which was present at time of fracture. Shortening measured  $1\frac{1}{4}$  inches on the roentgenogram.

film should exceed the actual measurement of the living subject by 5 per cent. Needless to say, all measurements were made with a wooden rule, and the same one used throughout.

CASE I—Boy (E G), four years of age Oblique fracture at junction of middle and upper third right femur Treatment consisted of overhead traction for three and one-half weeks followed by plaster cast for two weeks Had  $\frac{5}{8}$  inch shortening before

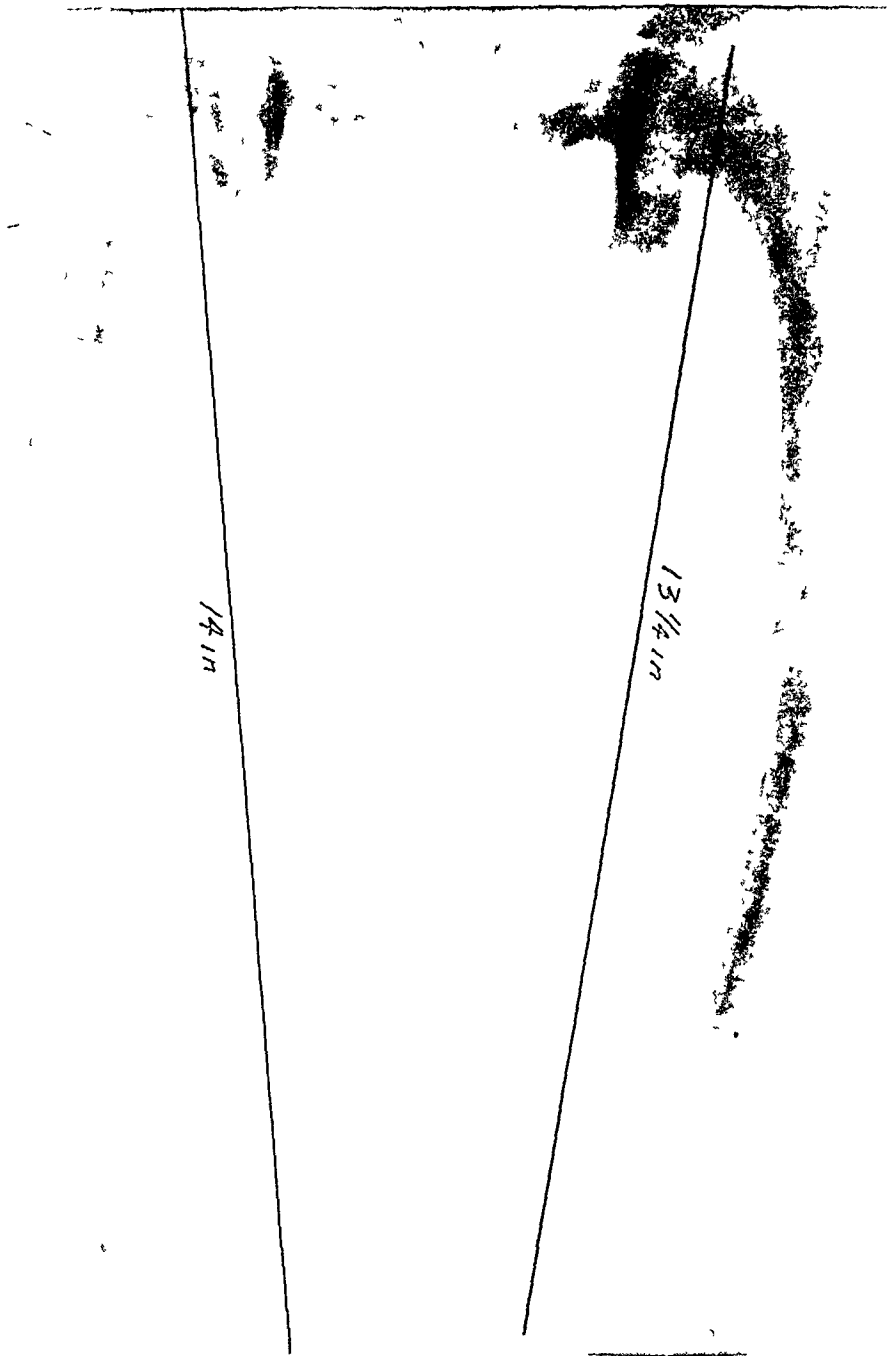


FIG 8—Case IV Fifteen months after fracture The shortening has been reduced from  $1\frac{1}{4}$ -ins to  $\frac{1}{4}$  in treatment started, and  $\frac{4}{8}$  inch at time of removal of cast, six weeks after injury Seen two years after injury No shortening demonstrable by any method of measurement including use of roentgenogram (See Figs 1 and 2)

CASE II—Boy (G S), three years of age Transverse fracture middle third right femur Treated by overhead traction for four weeks and plaster case for two weeks

## COMPENSATORY LENGTHENING OF THE FEMUR

Had one inch shortening before treatment and  $\frac{3}{4}$  inch shortening at the end of six weeks. Returned in two years. Measurements on the living body revealed practically no shortening—possibly  $\frac{1}{8}$  inch. Measurements of the entire femur and tibia on the X-ray film revealed a shortening of  $\frac{1}{4}$  inch. Measurements of the femur alone, however, revealed a shortening of  $\frac{4}{8}$  inch, indicating that compensatory growth may take place along the entire extremity as well as the femur. The right tibia measured  $\frac{2}{8}$  inch longer than the left. (See Figs 3 and 4.)

CASE III—(E. D.), boy, nine years of age. Oblique fracture of right femur at junction of its middle and upper third. Treatment consisted of overhead traction for four weeks and plaster cast for two and one-half weeks. Shortening before treatment was  $1\frac{1}{4}$  inches. When the cast was removed, shortening between the anterior superior spine and internal malleolus, trochanter and external malleolus, measured  $\frac{3}{4}$  inch. When seen one year later, the shortening had decreased to  $\frac{3}{8}$  inch. Combined measurements of the femur and tibia on the roentgenogram revealed a shortening of  $\frac{3}{8}$  inch, whereas the shortening of the femur alone measured  $\frac{5}{8}$  inch. The right tibia measured  $\frac{2}{8}$  inch longer than the left. (See Figs 5 and 6.)

CASE IV—(G. S.), boy five years of age. Oblique fracture of right femur in its upper third. Treatment consisted of overhead traction with Thomas splint to give support for bands to correct deformity. After four weeks, union was firm and plaster cast was applied. Measurements on

the roentgenogram revealed  $1\frac{1}{4}$  inches shortening, shortly after removal of the cast. Fifteen months afterwards, the shortening found by measurements on a roentgenogram had been reduced to  $\frac{3}{4}$  inch. (See Figs 7 and 8.)

### SUMMARY

It has been noted that compensatory lengthening will take place in the majority of cases of fracture of the femur in children. The amount of lengthening varies in each patient and is not dependent upon any form of treatment. It has been our experience when treating fractures of the femur in children that overhead traction offers the most comfortable and efficient method for restitution to normal function. Burdick<sup>5</sup> and Smith who have observed compensatory lengthening favor the use of Bryant's frame with

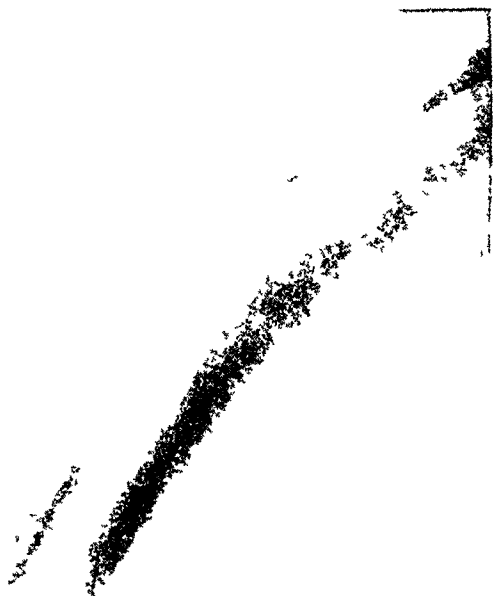


FIG. 9.—Shaft of femur one year after operative reduction with the aid of a Lane plate. Note extreme anterior bowing.

extension, but are inclined to believe the traction serves more as a factor of immobilization than as a method of decreasing overriding. Nevertheless, many cases have been observed in which the overriding was decreased considerably. It is desirable to get good alignment of fragments, and perhaps

more important than to overcome all of the shortening provided some portion of the ends of the fragments are in contact. It has also become apparent that operative reduction of fracture of the femur of children is very rarely indicated since deformity is so completely eradicated within two or three years after fracture, even though the fracture be transverse. Operated cases have given much less satisfactory end results because of bowing of the shaft after the Lane plates have been removed (See Fig 9). The only patient which was treated with an intramedullary peg, returned two months afterwards with a refracture at the site of the previous fracture. Incidentally this was the only case of refracture that was known to have occurred in this series of cases (See Fig 10).

#### CONCLUSIONS

1 Compensatory lengthening will take place in the majority of cases of fracture of the femur in children.

2 The location of compensations may be found in the tibia as well as femur.

3 Rarely is there indication for operative reduction.

4 Abnormal bowing of the shaft serves as one of the greatest factors of deformity and of disability, and in this series was seen only in operated cases.

#### BIBLIOGRAPHY

- <sup>1</sup> Cole W H. Results of Treatment of Fractured Femurs in Children. *Archives of Surgery*, vol v, p 702, Nov, 1922.
- Truesdell E D. Inequality of Lower Extremity Following Fracture of Shaft of Femur in Children. *ANNALS OF SURGERY*, vol LXXIV, p 498, Oct, 1921.
- David, V C. Shortening and Compensatory Overgrowth Following Fractures of the Femur in Children. *Arch Surg*, vol LX, p 438, Sept, 1924.
- <sup>4</sup> Brooks, B and Lehman, E P. Bone Changes in Recklinghausen's Neurofibromatosis. *Surg, Gynec Obst*, vol XLVIII, p 587, May, 1924.
- <sup>5</sup> Burdick, C G, and Sims, I E. Fracture of Femur in Children, Treatment, and End Results in 268 Cases. *ANNALS OF SURGERY*, vol LXXVII, p 736, June, 1923.

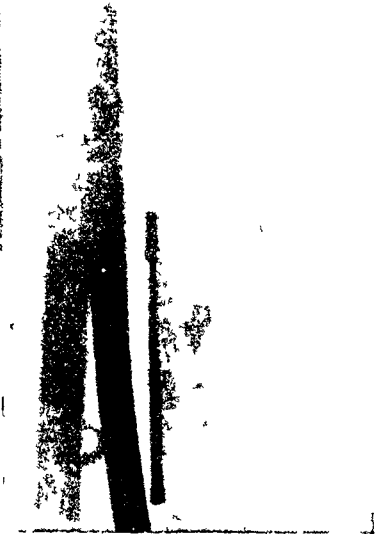


FIG 10.—Patient suffered a transverse fracture middle third on account of extreme overriding was treated by application of an intramedullary bone peg. Above roentgenogram reveals refracture which occurred at site of original fracture eight weeks after operative reduction and resulted from a minor fall. Roentgenogram two years later revealed healing without deformity, marked thickening of bone. Slight shortening still exists, no limp present.

# ACTIVE MOTION IN THE TREATMENT OF FRACTURES\*

BY JOHN LAWRENCE YATES, M D

AND

G W STEVENS, M D

OF MILWAUKEE, WIS

THERE are just and insistent economic demands for reductions in the durations in immediate and in extent of ultimate disabilities inevitable with customary treatments of fractures. Remedies are suggested by two axioms. Restitution of function is the chief therapeutic obligation. Recovery of function is more prompt and more complete as inhibitions of function are less complete and prolonged. The requirements, therefore, are to curtail the degrees and durations of immobilizations. Means to fulfil therapeutic requirements and to meet economic demands can be



FIG 1—June 12, 1924 Anteroposterior view showing fractures and faulty positions of fragments

developed by adapting practices to conform more directly with natural methods that foster the resistance, defense, growth and repair of bones

Man has been trying to record his observations and experiences for some thirty centuries, beset the while with difficulties and uncertainties. Rarely has he recorded only what he saw, infrequently he saw what he has recorded, and the few reliable records have failed but occasionally either to be ignored or misinterpreted by others. Hence it has ever been easier, and usually safer, for the less experienced to accept unquestioned the teachings of alleged constituted authorities. This is particularly true of dogmas promulgated with the

\* Read before the American Surgical Association May 6 1925 Radiographic and experimental work from the Laboratory Department, Columbia Hospital



supporting evidence of statistics which everyone can understand and none may believe. Man's credulity on the one hand and his faculties for organization on the other have resulted in the collection of real and potential authorities into units. If they are successful, the units automatically acquire authority, develop infallibility, preach ex-cathedra dogmatism and attempt to monopolize every line of endeavor, including efforts toward progress. During the past thirty decades, schools, guilds, associations, colleges, partnerships and clinics have been created. A brief survey of the history of fracture therapy and its

development under these influences will disclose reasons for widespread and growing dissatisfaction.

In the first epoch, extending up to Simpson, Pasteur and Lister, knowledge was restricted to gross anatomy and mechanics. Operations were few, anaesthetics relatively unknown



FIG. 2—October 10, 1924. Lateral view showing results from active motion after four months when bony union had become firm. Absence of atrophy and of excess callus formation, improved positions of fragments and preserved arch are noteworthy.

and notions of repair chimerical. Surgeons' attention was largely centred upon fractures. Excellent closed methods were devised to reappose fragments, many of which are useful to-day. External means were found to maintain reapposition with immobilization. It was noted that solidification resulted after periods that varied with the bone affected, the type of fracture and the age and condition of the patient. The doctrines of the first period were: To obtain accurate closed reapposition of fragments, to maintain reapposition with external fixation, and to continue reapposition and fixation immobilized until bony reunion had occurred.

The second period ended with the standardization of radiotherapy and radioscopy. It was dominated by the doctrines of morbid anatomists. Increasingly frequent open operations provided some conceptions of repair. The microscope disclosed cell arrangements associated with normal growth and the productions of bone after injuries but failed to interpret the practical significance of the sequence of healing processes. Many methods and much paraphernalia were devised to permit more accurate reapposition of fragments and to fix them by artificial impactions or by internal supports. All sorts and conditions of contrivances were evolved to secure immobilization. Some of them discredit the apparatus man has invented and employed throughout the ages to produce those exquisite discomforts that have obtained desirable

## ACTIVE MOTION IN TREATMENT OF FRACTURES

testimony from the uncommunicative and led divers sinners to profess recoveries from religious and political diseases

The opening of broader and more fertile fields for surgical interventions diverted the attention of general surgeons from fractures. Specialists appeared who contemplated skeletal defects exclusively and were given the care of fractures in the larger and more influential medical centres. The patients, because of the enthusiastic care of their bones by bone specialists,

came to take rather a secondary position. The mechanics of fracture treatment were developed so as to fulfil most real or fancied requirements for reapposition, fixation and immobilization. And still there was insufficient progress. The one opportunity to provide better care lay in a more accurate understanding of natural healing processes. The microscopists came to the rescue. They discovered good little cells that lived in holes and made bone, and called them osteoblasts, also bad big cells that lived in bone and made holes, and called them osteoclasts. They advised wisely that the activity of the osteoblasts be encouraged and those of the osteoclasts be discouraged, but failed to indicate the method to

accomplish these ends. These were priceless additions to knowledge, but not greatly to the advantage of unfortunates with bones to mend. They were, however, more serviceable than routinism based upon statistics, because two suggestions were implied, *viz.*, to treat individuals and not fractures, and to treat them in accordance with natural reparative processes. Nevertheless physiologic requirements were all but ignored. Man determined the conditions against which Nature must labor to effect repair.

The doctrines of the second period were. To obtain accurate reappositions of fragments by closed or open procedures, to maintain fixation by external



FIG 2a—October 10 1924. Anteroposterior view showing results from active motion after four months when bony union had become firm. Absence of atrophy and of excess callus formation, improved positions of fragments are noteworthy.

or internal appliances, and to continue reapposition and fixation immobilized until bony reunion had occurred

The third period opened mauspectiously for progress in the treatment of fractures. Medical authorities had agreed since the beginning on just what treatments were required. Man's ingenuity had provided means to meet the requirements. Fractures were being treated in medical centres by specialists who were devoting their lives to amelioration of skeletal defects, who thought

of nothing else in fact. Others less gifted, who were also treating fractures, need only follow their perfect practises to avoid the evil ways of the unorthodox which corrupt results.

However other influences became effective. Competitions in peace and war developed appreciation of values of man and woman power. With this appreciation came a growing recognition of handsome is that handsome does and that prompt functional recoveries were more to be desired than servitude to orthodox routine. Man's position in the biologic scheme and his subservance to biologic laws were established. Therewith a belated medical concept was evolved. All biologic knowledge can be applied in obtaining a



FIG. 3 — August 24, 1922. Anteroposterior view showing position of fragment.

clearer understanding of disease and no means to a better comprehension of disease will fail to afford more effective therapy. Radiography showed that some unrecognized fractures went on to remarkably good functional recovery when treated only with active motion restricted by pain. Radiography also proved that accurate reappositions and firm fixations of fragments were not only unessential to perfect recoveries of function, but also that such reappositions and fixations were no assurance of satisfactory recoveries. Experience taught the wisdom of neglecting fractures in attempts to avoid fatalities in infirm patients. The bone healing sometimes was astonishingly good, indeed

## ACTIVE MOTION IN TREATMENT OF FRACTURES

the results could be better than had routine methods been employed. Occasionally a person denied all assistance, because of isolation, would suffer from so severe an injury as a compound fracture of the femur and would recover. Survival demanded active motion, pain controlled it. The healing could be equal, even superior to that obtained under the care of adept surgeons. Thus came gradually the proofs of facts. Reapposition of fragments, then fixation and immobilization, are unessential to excellent recoveries under certain conditions, but under those conditions active motion is a constant factor. Willemss

and Dehez demonstrated the beneficent influence of active motion in preventing ankylosis and hastening recoveries from severe acute arthritis and peri-articular fractures caused by war injuries. Rollier proved that active motion is an essential element in permitting functional recoveries from bone and joint tuberculosis.

Another series of observations have been made in the clinics and experiments. Nature has



FIG. 4—February 1, 1924. Anteroposterior view showing union in perfect position and no evidence of callus.

been conducting for upward of thirty million years. Wild animals and birds sustain fractures, the survivors, be they few or many, recover often with excellent function. They are able to move rapidly, to fight and to mate. Wild animals in captivity also sustain fractures, but seldom escape man's interference. The results are usually poor. Left to their own devices animals remain inactive for a time and then gradually increase their general activities and the stresses placed upon the broken bone. The results are usually good. Domestic animals are less fortunate. They are either promptly killed to terminate suffering that supposedly can eventuate only in crippling deformities or they are subjected to the indignities of plaster casts which they immediately attempt to remove. The results are usually bad and are attributed to the impossibilities of maintaining immobilization. If allowed to be guided by instinct, domestic animals follow the procedures of the unmolested wild folk in captivity.

Apparently relaxation of muscles follows the spasm produced by the painful irritations of injury. Traction furnished by dragging, gravity and the pull of opposed muscles suffices to provide adequate spontaneous reapposition. Moderate activity reinforced with the warmth supplied by licking prevents hypoenia. Continued activity hastens the formation and solidifications of callus.

The results from the natural methods of treating fractures are not all good, and when poor they are usually atrocious. Much the same may be said

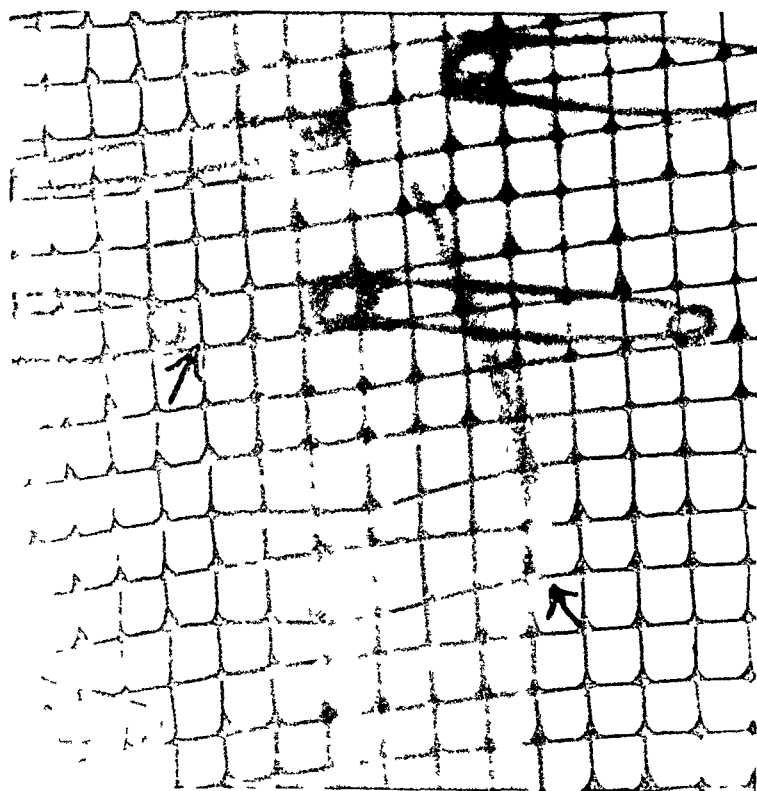


FIG 5—January 23 1924. Shows the extensive fragmentation and alignment obtained after use of calipers

of the outcome when fractures are treated by men. Presumably there are combinations of artificial and natural procedures that can be employed so as to minimize the shortcomings of both.

The brilliant clinical and experimental investigations of Allison and Brooks<sup>1</sup> have furnished the information needed for an understanding of the practical significance of active motion and its relationship to resistance defense

growth and repair of bones. They proved that non-use, however it may be caused leads to atrophy of bone which can be recognized radiographically within a few days after immobilization, and is progressive. Atrophic bone bends and breaks under less stress than normal bone according as it is more pliable or fragile and as the relatively excessive forces are applied gradually or abruptly. Atrophic bone differs physiologically from normal bone in retarded growth, in premature epiphyseal ossification and in reduced powers of resistance, defense and repair. Atrophy is produced by removal of normal stresses and strains of activity and by the hypoenia inevitable with inhibition of function. Lesser degrees of atrophy are corrected promptly by restoration of function which is active motion. Greater degrees of atrophy are corrected more gradually provided the stresses are not intolerable to the amount of bone present and are not applied abruptly enough to cause fracture.

<sup>1</sup> Surg, Gynec and Obst, 1921, vol xxxiii, p 250, Arch Surg, 1922, vol v, p 499

## ACTIVE MOTION IN TREATMENT OF FRACTURES

or so constantly as to cause deformities by exaggerating the normal curves of bones. Extreme degrees of atrophy, osteoporosis, prevent restitution of normal bone architecture.

Two features can be noted radiographically as bone atrophy develops and disappears. The total amount of bone visible in the intensities of shadows varies with the extent and duration of non-use and of re-use. There are even greater fluctuations in the denser cortical portions and more particularly in the lamellated structures which normally are more accentuated along the lines of stress. Absence or faintness of these lines which show stress-bearing capacities indicates incompetence to withstand normal function. Conversely, the re-appearance of these lines in the radiograms is commensurate with re-turning competence.



FIG. 6—February 13, 1924. Shows application of plaster cast so that patient could have unrestricted movement of knee joint, also shows position of fragments at this time and absence of atrophy one month later.

Formations of callus are comparable to healing processes noted in the repair of soft tissues. Callus, like granulation tissue, is developed to bridge gaps and to provide fixation, and the total production exceeds actual demands. Both are responses commensurate with the intensity and duration of irritations. When bone healing is of a primary type the callus may be well nigh undemonstrable radiographically. As bone repair departs from the primary type because of malappositions, repeated hemorrhages, infections and the presence of foreign bodies, including sequestria, the callus productions increase in amount and become progressively less physiologic and correspondingly more pathologic. Thus there arise formations of callus that simulate exuberant growths of granulation tissue and those more comparable to keloids. The former is more and the latter is less amenable to the influences leading to involution of callus.

Callus is comparable to atrophic bone in that there is less than normal amount of bone within its periphery. Stresses imposed upon callus produce, as in atrophic bone, the development along appropriate lines of intensified or more compact structures. As activities are induced and continued these more

compact structures increase and bear the larger proportion of burdens. The remaining callus, less and less exercised, undergoes the atrophy of non-use. It is, therefore, clear why prolonged and excessive irritations increase the amounts of callus formed, and why excess callus, being rather pathologic than physiologic, responds less readily to the influences leading to involution. More important still from a practical standpoint is the knowledge that the earliest development of accentuated structure, attainable solely by active motion, limits to an irreducible minimum the total amount of callus formed.

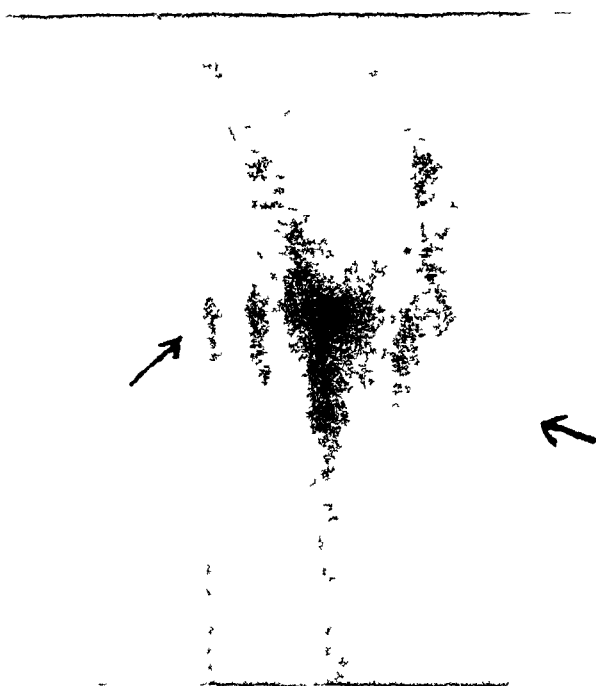


FIG. 7 — May 26, 1925. Repair eighteen months after injury provides perfect function despite anatomic abnormalities and typical lines of stress. No excess callus was present at any time.

On the other hand, immature callus, like atrophic bone, breaks and bends under less stress than normal bone. Resumption of activities has to be tempered with reason. Callus is competent only when those portions of its architecture are sufficiently developed to bear full burdens, and in consequence the burdens imposed must be restricted to the limitations in competence. The amount and distribution of callus may fail to indicate competence. The presence of increased density demonstrable radiographically

in structures along lines of stress is more trustworthy evidence of the degree of maturity of the callus and its capacity to withstand stress.

Joints add a serious complication to fractures. Some fractures are always associated with hemarthrosis, most fractures may be associated with hemarthrosis; and all fractures can be associated with traumatic arthritis. Acute traumatic arthritis, if immobilized, produces intra-articular fibrinous adhesions (Deliez) which precede fibrous adhesions. Fibrous adhesions are precursors of bony ankylosis (Hoffa). The one certain means to prevent organized intra-articular adhesions is suitable active motion (Willems). Immobilization of extremities produces atrophies and rigidities of normal joints which are corrected by resumption of motion, most certainly by active motion. All evidence thus far presented is but a confirmation of a homely philosophy—uninterrupted functions never cease.

The most troublesome and important complication of fractures, and the one too frequently given the least consideration, is the patient. Immobilization of an extremity causes atrophies and rigidities not restricted

## ACTIVE MOTION IN TREATMENT OF FRACTURES

to bones and joints. Similarly, the immobilization of an individual causes the atrophies and rigidities not limited to skeletal structures. As already noted, a neglected fracture can heal with an excellent recovery of function if all attention is centred upon keeping the patient alive. Perfect reapposition and fixation of fragments and the most comprehensive system that guarantees complete immobilization, obtained and maintained with ceaseless attention of the highest order, are somewhat futile if the patient perishes or becomes demented. Wherefore, there is wisdom in so regulating treatment that each individual be kept at the uppermost level of physiologic competence

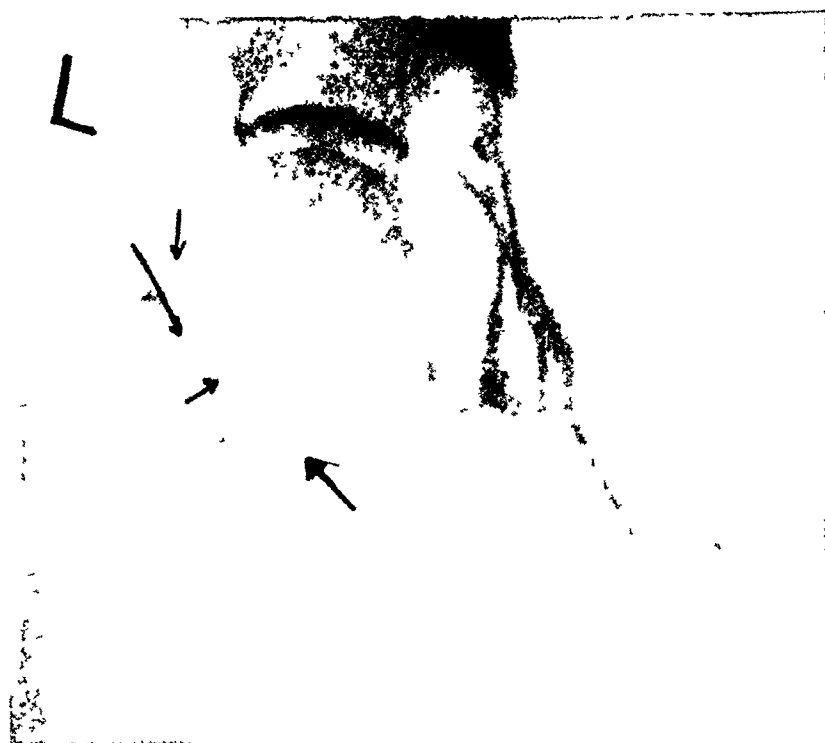


FIG 8—January 27, 1924. Impacted fracture of neck of left femur. Fracture line indicated by arrows.



FIG 9—March 3, 1924. Shows state of healing after five weeks. Atrophy is not demonstrable, no callus is to be seen, lines of stress are reforming.

which assures the highest general and local powers of resistance, defense, growth and repair as well as the largest opportunities for compensations and adaptations. Moreover, this scheme can still be advocated if, after healing is complete, functional recovery surpasses the cosmetic result.

### SUMMARY—

Consideration of the more essential local and general actions and reactions associated with fractures and their treatments by natural and surgical methods indicates the nature of procedures compatible with



therapeutic requirements which will more nearly satisfy economic demands. These are to protect each function against avoidable inhibitions and to secure

undelayed rehabilitation of every function. The means are to limit anatomic changes and to favor the reparative processes leading to restorations of the remote and local tissues more important to the patient. Normal structure assures normal function. The most important functions provide individuals with living competence. Dancers and pianists for example would be more likely to differ

FIG. 10—May 5, 1924. Complete restoration of weight-bearing lines in head and neck of femur across line of fracture and in ilium across the joint. No recognizable callus.

in their evaluations of integrities of hands and feet than of brains and hearts.

The following therapeutic details are noteworthy:

1. Treat the patient suffering from a fracture and not the fracture complicated by a patient.

2. Adopt such procedures as will interfere the least with general and local activities and which will permit the earliest resumption of unrestricted activities.

3. Reapposition of fragments.

- (a) Attempt to secure with the least traumatism the reapposition essential to functional recovery.

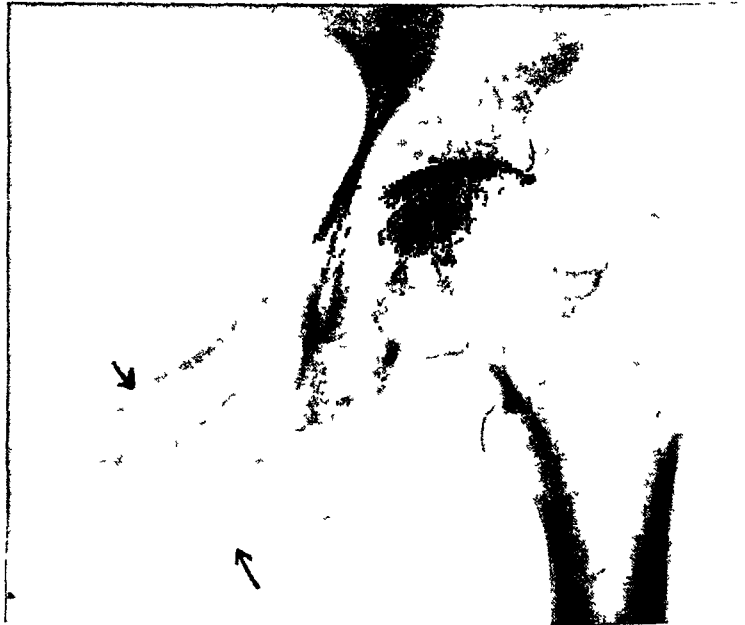


FIG. 11—December 1, 1924. Fractures indicated by arrows. Fragments could be seen with fluoroscope to move slightly with weight-bearing.

## ACTIVE MOTION IN TREATMENT OF FRACTURES

(b) If impaction is present and position of fragments is compatible with recovery of function, do not meddle

(c) If spontaneous reapposition has occurred and the fragments are in satisfactory position, do not meddle

(d) If reapposition is useless or impossible, do not meddle

(e) If fracture is incomplete and alignment protects against subsequent deformity, do not meddle

(f) Manipulations to obtain reapposition are least harmful when conducted under visual control furnished by fluoroscopy

(g) Full apposition obtained immediately by closed manipulations or

presently by traction is usually preferable to more exact open reapposition

(h) If open methods must be employed the earlier the better, other conditions duly considered

### 4 Fixation of fragments

(a) The less fixation and support employed beyond the requirements for safety, the more perfect the repair

(b) Many impacted fragments and some well-apposed non-impacted fragments require no fix-

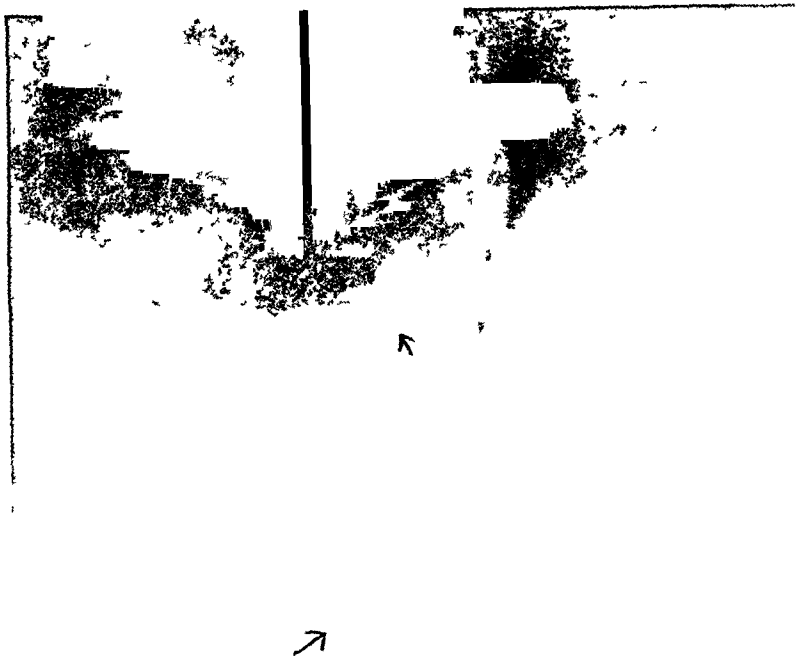


FIG 12—February 5, 1925 Extent of repair attained after nine weeks of active motion. Fragments are better apposed, atrophy was obviated, and excess callus formation was avoided

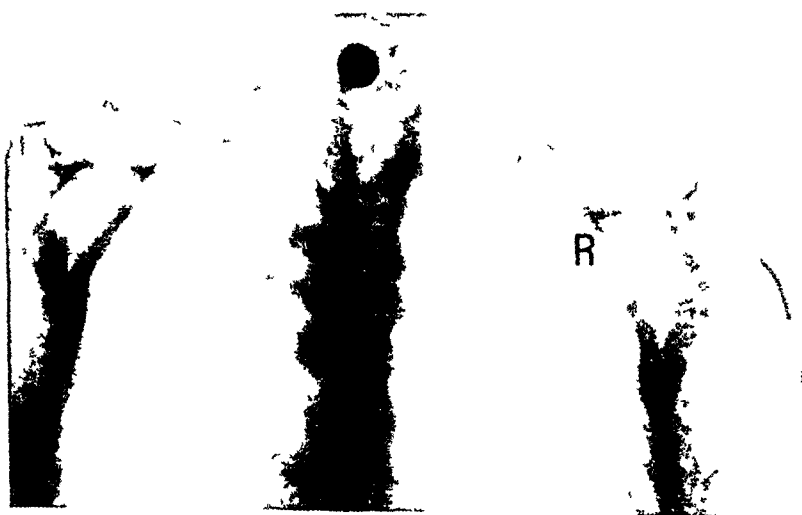


FIG 13—October 20, 1924 Fracture of right clavicle had occurred sixty-two years previously. Plate illustrates healing obtained when treated with active motion alone

ation, and, exceptionally, may require no support

(c) Fragments that can be neither reapposed nor fixed need only tem-

porary support to restrict pain and to avoid further injury while active motion is being instituted

(d) Fragments that can be reapposed but not fixed by external means may require internal fixation

(e) Internal fixation causing the least irritation is preferable, artificial impaction, iso-bone grafts or foreign bodies are available means

(f) Absorbable foreign bodies are not invariably preferable to the less irritating non-absorbable foreign bodies or to those physically more dependable

(g) Usually the more dangerous foreign bodies should be removed soon after they cease to be effective in providing fixation

(h) Nails, pegs and screws loosen as contiguous bone atrophies which occurs sooner if motion is prevented and the entire bone becomes atrophic

#### 5 Immobilization

(a) When safety permits, immobilization should be avoided

(b) Unavoidable immobilization should be interrupted at early intervals partly by passive and partly by increasing active motions

(c) Plaster casts are undesirable unless they permit of earlier active motion than other apparatus since they exclude the beneficence of sunlight

(d) Calipers, splints and frames can often be employed with less discomfort and so as to allow earlier active motion, particularly of joints

6 Collateral measures Diet, massage, manipulations, heat, light, placing patients in the open air, blood transfusions, physiotherapy—indeed, everything that will hasten repair and satisfy exactions of patients and friends is desirable

CLINICAL OBSERVATIONS—Notes and comments on a small series of patients treated for various fractures will illustrate possible achievements



FIG 14—January 11 1924 Impacted fracture of neck of right humerus

## ACTIVE MOTION IN TREATMENT OF FRACTURES

when the methods employed cooperate with natural processes of repair. Mistakes have been made. Dangers will be mentioned.

I—Laborer, aged forty-seven years. Crushing of foot, June 12, 1924. Fractures of second, third, fourth and fifth metatarsal and fragmentation and crushing of second and third cuneiform bones (Fig 1). Slight laceration of soft parts. Foot much swollen, densely oedematous. Hot wet dressings applied and extremity kept elevated for a few days. Then a snug flannel bandage employed and active motion begun, walking with aid of crutches. Patient's cooperation limited but capacity for moonshine unlimited. Materially improved though progress delayed by failure to walk properly. Condition four months later, October 10, 1924, shown in Fig 2 and Fig 2a. Has been working for five months as usual. Some deformity present. Disability slight not interfering with active motion. Discharged by company, January 29, 1925, because of drunkenness. Disability rated at zero.

*Comment*—Reapposition and fixation of these fragments was impossible. Active motion was employed early to secure the least undesirable reapposition of fragments and to assure fixation and healing in those positions. Absence of atrophy in Fig 2 and Fig 2a is noteworthy as fixation of



FIG 15—October 17, 1924. Healing obtained in nine months treated only with active motion. Function excellent. No atrophy. No excess callus.

feet in casts, if immobilization is protracted leads to extreme atrophy, the osteoporosis often being mistaken for inflammatory bone destructions. This is a common point of dispute in settlement of claims for permanent disability compensations. Fractures of this type including many fractures of the os calcis, heal unsatisfactorily and lead to prolonged, often permanent, disability when treated with casts and non-use. Patients who will try to walk naturally *i.e.*, without limping, if only for a few steps at a time, achieve the more complete and undelayed recoveries of function. Occasionally bicycle riding is an excellent means for getting suitable exercise. The greatest dangers of active motion therapy are that the patient's courage and persistence will be unequal to the tasks, or his confidence will be destroyed by friendly advice and legal counsel. Failure to regain function under these conditions will be attributed to the treatment advised and not to the lack of cooperation. Corporations are liable to be unjustly taxed for industrial compensation unless the State Commission is aware of the real causes. The Wisconsin Commission has been fair to both sides in these controversies.

II—Nurse aged thirty-three years. Fell, fracturing right internal malleolus August 24 1922 (Fig 3). Adhesive plaster corset applied to foot, ankle and leg. Continued rather strenuous duties of caring for active children. Pain lasted for a few days. Recovery perfect. Nature of ultimate healing shown in Fig 4, February 1, 1924.

*Comment*—This patient was advised by other surgeons not to accept treatment that assured non-union and permanent disability. Such attitudes are the rule and indicate the risks of departing from convention. They illustrate nicely the type of testimony certain to be presented if a dissatisfied patient seeks legal redress. Protection can be secured in advance by making the patient or those responsible choose between natural and orthodox procedures after facts have been presented. If patients are incapable of obedience it is wise to refrain from attempting the impossible.

III—Secretary, aged forty-three years. Struck and dragged nearly a block

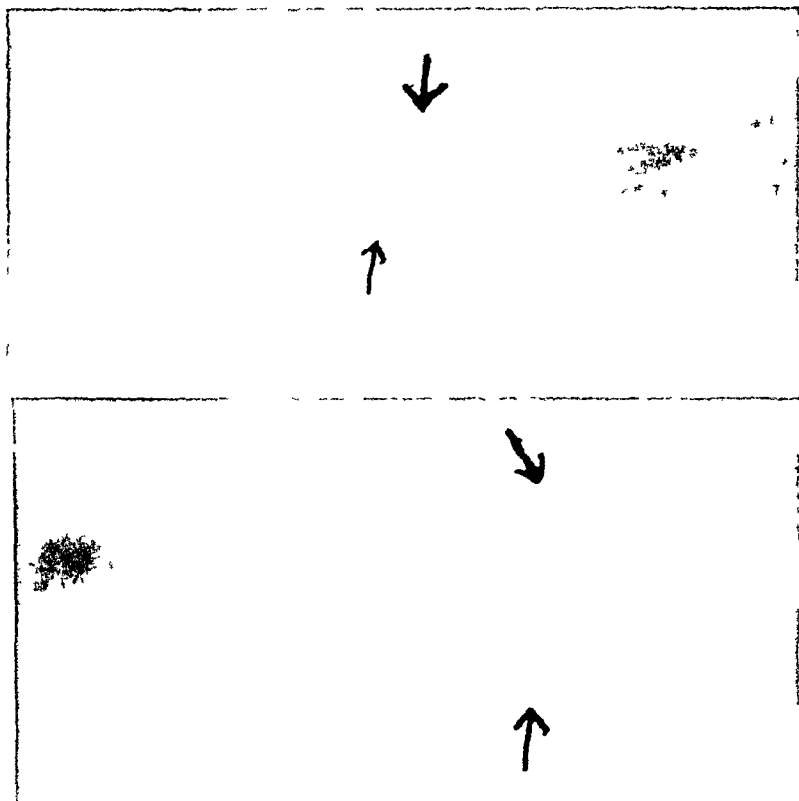


FIG 16—April 20, 1925. Anteroposterior and lateral views of forearm showing position of fragments after over-correction.

by an automobile, January 17, 1924, sustaining comminuted fractures of upper right tibia and fibula, hemarthrosis of knee, cerebral concussion, shock, and traumatic pleuritis. Figure 5 shows positions of fragments after traction secured with calipers applied to malleoli. Hot dressing to knee which was not aspirated. Early passive motion to knee. Plaster cast applied to leg as soon as fragments had become partly fixed. February 13, 1924 (Fig. 6). Active motion with slight weight-bearing begun and gradually increased. Recovery complete in five months. Walks to and from office sixty blocks each day. Her left leg is more easily fatigued. No real disability. Figure 7, May 26, 1925, shows nature of healing eighteen months after injury that has permitted complete recovery of function along atypical lines of stress. Functionless bone has disappeared through atrophy of non-use, leaving a rounded outline. At no time was there formation of excess callus.

*Comment*—This woman had courage, faith, and persistence. Her healing shows that failure to obtain accurate reappositions of fragments was of little moment. Increased densities show the abnormalities in lines of weight-bearing stresses. Atrophy of non-use has reduced certain projections. Active motion prevented excess callus formation and rigidity of her knee-joint. Her total distress was great but less in degree and in duration than had immobilization been prolonged. The progress she made was satisfactory but would have been more rapid had not timidity resulted from the accident. Shyness of motor vehicles persists as the only remaining complication.

IV—Business man, aged forty-eight years. Fell January 26, 1924, sustaining an impacted lateral fracture of neck of left femur (Fig. 8). Was able to walk imme-

## ACTIVE MOTION IN TREATMENT OF FRACTURES

diately Diagnosis established by inspection and radiogram No manipulation Was less comfortable if leg was supported with sand bags when prone No traction employed Active motion not interrupted Patient had to be restrained from overactivity so that callus could mature without danger of giving away gradually or suddenly Back at his desk in ten days Used two crutches on the street, one crutch and then only a cane when indoors State of healing in five weeks shown in Fig 9, March 3, 1924 Intensifications along new line of weight-bearing stresses can be seen to have crossed lines of fracture and even across hip-joint No atrophy is present Absence of callus is striking in this radiogram There never was any joint stiffness attributable to hemarthrosis Started on an arduous business trip March 5, 1924, of three weeks' duration Returned home before orthodox methods would have permitted weight-bearing Condition ninety-eight days after injury showed in Fig 10, May 5, 1924, when the stress-bearing lines in femur and ilium are clear At present he is able to walk with but slightly increased fatigue, to climb stairs without restrictions, and to run without evidence of handicap His limp and eversion of foot are barely perceptible

*Comment*—Deformities caused by impacted fractures of necks of femurs are so seldom remediable by external force that it is questionable if such procedures should be attempted, particularly in older patients All solidly impacted and most partially impacted fractures can be treated from the beginning with active motion adapted to meet individual requirements

Some require support, particularly at night, others are better off with none Too much weight-bearing is dangerous because impaction can give way suddenly, when pseudo-arthritis are likely to develop, or gradually with resulting deformity and much increased disability Impacted fractures are so much less painful than the unimpacted and the results attainable when impacted fractures are treated with active motion are so superior that two plans for treating unimpacted fractures suggest themselves either to maintain reapposition with some means that will permit motion, hasten repair and allow active motion to be resumed earlier than has been possible heretofore or to create impaction and begin active motion forthwith Traction in extension and abduction can be provided with weights pulleys and a frame so that reapposition and support can

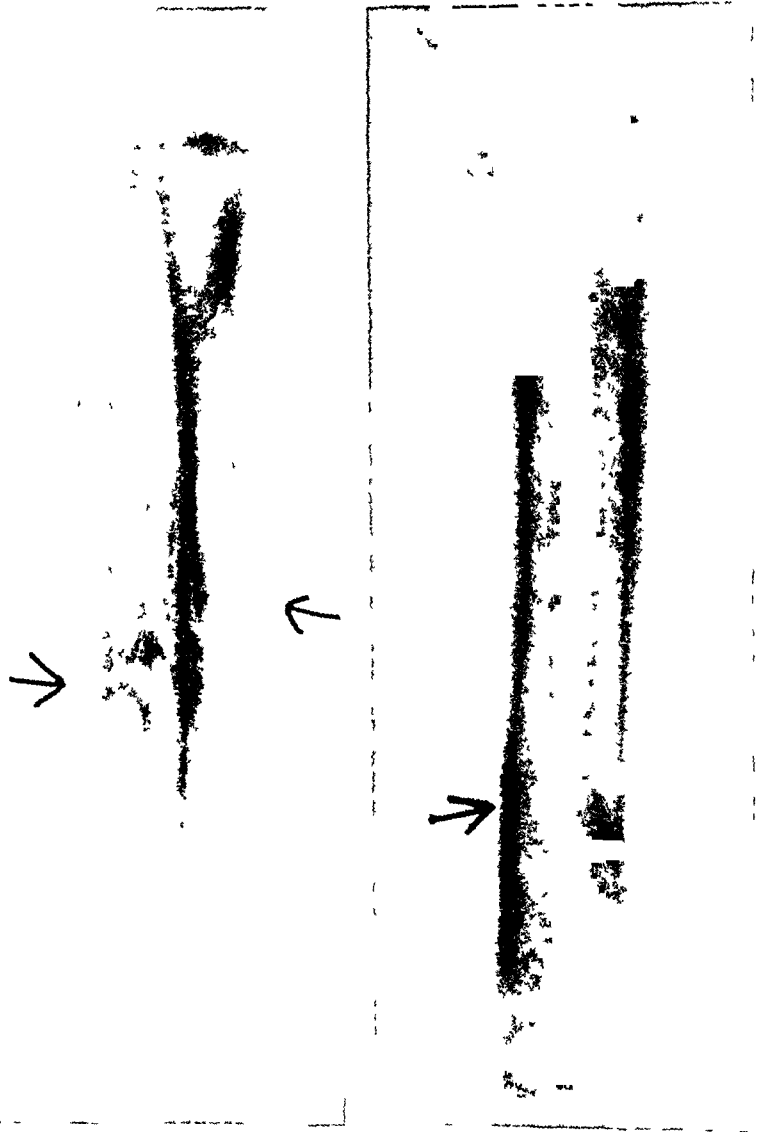


FIG 17—May 9 1925 Shows progress of healing and of callus formation in nineteen days, also fracture of other radius

be given and yet allow a considerable range of activities to the bedridden. Similar traction, rotation and abduction can be transferred to splints and allow walking on crutches with some active motion though not weight-bearing. Repeated radiotherapy and radioscopy will determine whether reappositions and fixations are compatible with good functional recovery. Or under spinal anaesthesia to provide relaxation without deep narcosis, the fragments can be reapposed with the aid of fluoroscopy and then fixed by driving a heavy spike through great trochanter, neck and into the head. Most of the pain is relieved, active motions can begin at once and, by preventing excessive bone

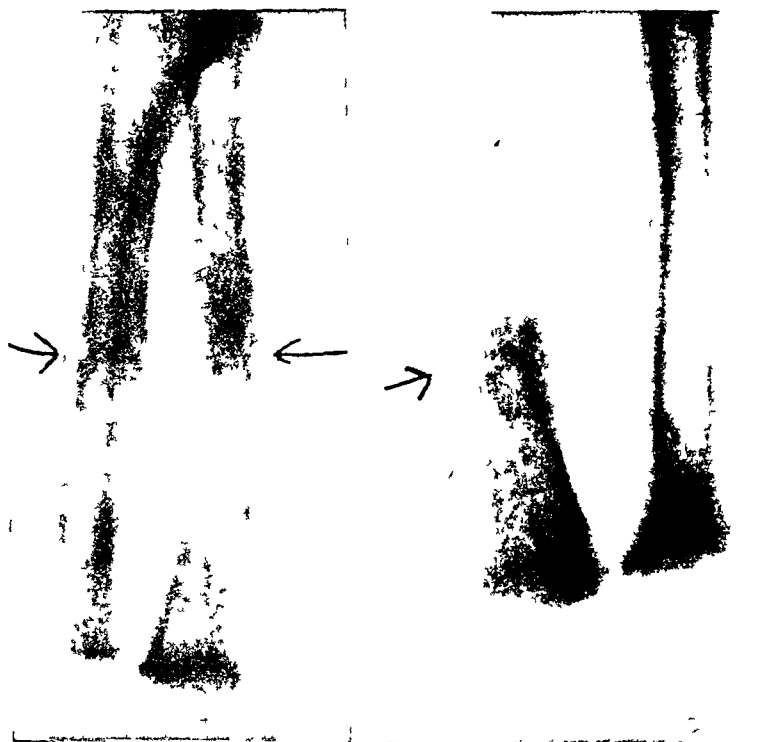


FIG 18—Formation of callus limited. Early restitution of stress-bearing structures. Prompt and complete recovery of function.

atrophy, permit natural fixation to develop effectively before the spike becomes loose and should be withdrawn. Our experience is as yet too limited to allow positive statements. Apparently both plans are feasible and practicable enough to be worthy of attention to develop their usefulness.

V—Grandmother aged sixty-four years. Injured December 1, 1924 in an automobile collision fracturing horizontal and descending ram, left pubic bone (Fig 11). Her family was told the nature of her lesions. She was per-

suaded that minor lacerations healed best when treated with contempt. A snug adhesive plaster corset was applied. She kept about her housework and went up and down stairs with little assistance. Her recovery was quite complete in three weeks, Fig 12, February 5, 1925, shows the bone healing obtained. Now aware of the more serious nature of her injury, this maiden is quite proud of her achievement and courage. Had she known of the fracture at first she might well have been too timid to keep moving.

*Comment*—Bilateral fractures of the pelvis and those complicated by visceral lesions (e.g., perforations of the bladder) require suitable periods of inactivity but far less than is supposed to be necessary. Patients with such fractures need support but should be encouraged to keep moving their legs and to shift their positions as early and as often as pain permits. Getting into wheel chairs and trying each day to indulge in more self-help provides profitable diversions that hasten recoveries.

Fractures of ribs, sterna, vertebrae, scapulae and jaws can be treated with active motion and excellent results obtained. Lack of satisfactory radiographic evidence of the positions of fragments before and after healing that would illustrate repair prevents presentation of specific examples.

VI—Physician, aged seventy-two years. Fell from a tree when ten years of age and fractured right clavicle. He had been coveting his neighbor's fruit and omitted mention of his mishap. Maternal watchfulness detected reduced exuberance. The family

## ACTIVE MOTION IN TREATMENT OF FRACTURES

physician recognized the cause. He did not meddle. The present condition, Fig 13, October 29, 1924, is evidence of his wisdom.

*Comment*—Most fractures of the clavicle treated by motions designed to produce reapposition or only by neglect will heal perfectly. Some overlapping and deformity therefrom and from callus may result. Interference with function is unknown. Delrez proved in his treatment of soldiers with fractured clavicles that active motion resulted in the least duration and extent of disabilities. Girls and athletes are the exceptions that require intervention if overlapping of fragments threatens. Application of the crucifix splint is said to be comforting, the name is not.

VII—Grandmother, aged eighty-one years. A fall down stairs, January 11, 1924, caused an impacted fracture of the neck of her right humerus (Fig 14). She was bullied into trying to take care of herself from the first. She escaped a permanently stiff and painful shoulder and regained a competent arm in a few months. Figure 15, October 17, 1924, shows the improvements obtainable through activities by older people.

*Comment*—Injuries near the shoulder-joint, either in humerus or scapula are prone to terminate in obstinate stiffness and persistent pain if immobilization is permitted. The earlier activities are resumed after injury, the more conscientiously they are continued and increased, the more prompt and complete are recoveries.

VIII—Boy, aged twenty months. Fell April 18, 1925, achieving green-stick fracture of both radius and ulna, which was not recognized until April 20, 1925 (Fig 16). Deformity was overcorrected and a splint applied to the extensor aspect of the forearm that permitted constant use which was encouraged. Fell again May 9, 1925, breaking the other radius (Fig 17), which received no treatment save reflex restriction of motion from pain inhibitions. Results showed on Fig 18, May 20, 1925. Limited callus formation, early restitution of intensities along stress-bearing lines, absence of atrophy and complete rehabilitations of functions which were never interrupted show that the methods were not harmful.

*Comment*—This youngster's experience illustrates the necessity of supplementing

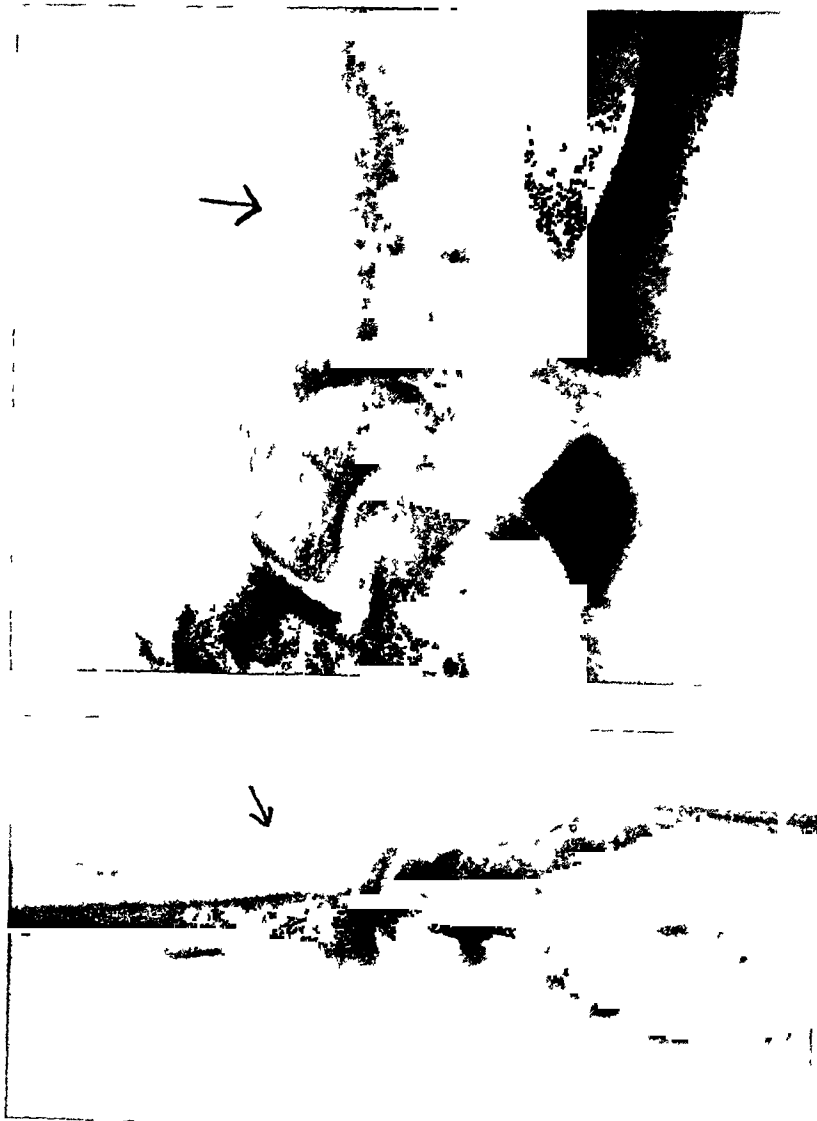


FIG 19—January 17 1925. Line of fracture and slight impaction both evident



natural methods to obtain the structural recoveries needed for normal function and the wisdom of interfering as little as possible with those methods

IX—Housewife, aged twenty-two years Fell January 17, 1925, and achieved a Colles' fracture (Fig 19) Well apposed fragments were probably impacted Used a sling to support the forearm Hand dependent, enforcing flexion and adduction of wrist Knitted a great deal Prompt recovery without deformity or disability A skiagram, February 2, 1925, showed the bone-healing to be reliably strong Radiogram, Fig 20, taken May 25, 1925, proves that the slight degree of early atrophy had disappeared and

shows the final repair Function perfect

*Comment*—Colles' fractures are treacherous when treated with active motion unless an extreme overcorrected position is maintained between exercise periods Muscle pull is likely to produce abduction Deformity can develop even after the callus appears to be more than adequate to assure fixation Our two most serious blunders have been in treating these lesions because the dangers



FIG 20—May 25 1925 Healing obtained in four months with active motion Despite disappearance of normal curve of radius functional recovery was perfect

were underestimated Too much confidence was placed in the amount of callus and too little attention paid to the lack of accentuation of bone structure along the lines of stress

CONCLUSIONS—Reasons have been given to show why bone repair occurs more promptly and advantageously, if active motions are employed Evidence has been presented to prove that cooperation with the natural reparative processes leads to earlier healing and more complete functional recoveries than are obtainable by the orthodox procedures wherein immobilization is enforced

Progress made in treatment is commensurate not only with reductions in mortality rates, but also with restrictions in durations of immediate and in extent of ultimate disabilities Advances are noticeable when therapeutic procedures cooperate with natural processes which include resistance, defense, growth and repair

Treatment of fractures, so as to cooperate with Nature's methods of healing is the one way to obtain better results

Active motion is a constant factor in recovery and no recovery is complete until unrestricted active motion is possible

The earlier active motion is instituted the more prompt and complete are recoveries, provided a development of deformities is prevented during the healing process

Methods of treating fractures should be designed to interfere the least with general activities and to permit the earliest resumption of active motion by the structures involved in the injury

## TRAUMATIC LUXATION OF THE HEAD OF THE FIBULA\*

By HENRY H. M. LYLE, M.D.

OF NEW YORK, N. Y.

ISOLATED dislocations of the superior tibio-fibular joint are often observed as the result of disturbances in growth, after acute osteomyelitis and in complicated fractures of the upper end of the tibia and fibula. Occasionally it occurs as a complication in amputation stumps. Simple traumatic dislocations of the head of the fibula are, on the other hand, extremely rare. We have collected forty-one cases,† thirty-nine from the literature and two from our practice. We do not believe that these figures represent the true frequency as many cases are undoubtedly unrecognized and others being of minor import are not reported.

The dislocation occurs most frequently in young adult males. The youngest recorded case is an infant of eighteen months, the oldest a man of fifty-two. The displacement may be forward, backward or upward. It is caused by muscular action or direct violence.

*Forward Dislocation*—As the head of the fibula is situated behind the most external part of the tibia a dislocation forward must also be outward. We have collected twenty cases of forward displacement. The number includes Vaccari's unique case of double dislocation. While the majority are caused by a fall with the leg bent under the body, a few result from muscular action without a fall. Stimson believes that the forcible depression and inversion of the front of the foot may be a factor in the production and cites Savournin's and two of his own cases in evidence. Hirschberg's and Emmert's cases come under this head. Klose's patient, in attempting to spring up from a kneeling position, displaced the head of the fibula forward, the dislocation probably resulted from an overcontraction of the extensor muscles arising from the side of the fibula, the head being drawn forward by their forcible contraction. This is the reverse of the posterior dislocations, here the displacement is brought about by the violent contraction of the biceps. Tillaux does not believe in the theory of muscular contraction. He concludes from experiments on the cadaver that when the tibio-fibular ligaments, as well as the malleolus, remain intact, the result is either a fracture of the fibula or a luxation of its upper end. He cites a transverse fracture of the tibia above the tibio-fibular ligament which was accompanied by a simultaneous luxation of the head of the fibula. Spiral torsion fractures of the tibia are quite frequently accompanied by a higher complimentary fracture of the fibula. If the fibula remains intact and the force continues, we believe that in a few cases the head of the fibula is dislocated or the joint capsule severely strained.

---

\* Read before the American Surgical Association, May 6, 1925.

† This figure does not include Cooper's and Shaw's traumatic cases, Fenwick's congenital Bryant's pathological or Lyle's amputation stump cases.

Lately it has been our practice to make a careful examination of this joint in all fractures of the tibia and we have been surprised by the number of cases in which this joint has evidently been damaged

*Backward Dislocation*—We have collected twelve cases of this displacement. A few cases are caused by the forcible contracture of the biceps others by direct external violence, while the majority follow a fall. In these cases the following mechanism probably occurs the leg is twisted, the superior tibio-fibular ligaments rupture and the loosened head of the fibula is drawn backward by the biceps. In the posterior dislocations the leg is held in a flexed position

*Upward or Total Dislocation*—This displacement is caused by an upward thrust of the fibula and is associated with trauma to the ankle. From a practical standpoint it is a dislocation upward of the whole bone. Four cases are reported Boyer's Stoll's Sorbet's and Stromeyer's. Boyer's case was associated with an outward dislocation of the ankle in which the fibula instead of breaking, was forced bodily upward. Stoll's patient, a circus rider, leaped from his horse and alighted on his toes. Stimson believes that Sorbet's case is too incomplete to be included. In Stromeyer's case the force acting from below on the outer edge of the foot forced the fibula upward.

*Double Dislocations*—There are five cases four of these are upward displacements and the fifth is Vaccari's case in which the head of the fibula was displaced forward and the malleolus backward. The patient, a man aged fifty-two, while intoxicated fell with his leg flexed under his thigh the foot being in forced flexion and abduction.

*Symptoms*—The acute cases complain of severe pain and tenderness over the joint the chronic cases experience a feeling of weakness. Although the patient may not be able to walk on account of the pain active movements at the knee are possible. A sharp pain high up on the fibula produced by evertting the foot is considered by Cotton to be a pathognomonic sign. In the double dislocations there is in addition pain, tenderness and swelling of the ankle. Motor and sensory symptoms referred to the external popliteal nerve are present in a few cases and vary from slight sensory disturbances to paralysis and permanent drop-foot. In the anterior displacements the leg is extended and the foot adducted, in the posterior the leg is held in a semi-flexed position. The tenseness and direction of the biceps tendon varies with the dislocation. In the anterior dislocations the biceps stands out as a tense curved cord with concavity forward, in the posterior it is tense and vertical, in the upward displacement the tendon is relaxed.

The head of the fibula can be seen and felt to be displaced. The displacement is readily verified by comparing the measurements of the injured knee with those of the normal. For this purpose the distance from the tuberosity of the tibia to the styloid process of the fibula makes a convenient comparison.

Abnormal mobility at the superior tibio-fibular joint is present in 20 per cent of the cases, slight mobility in 60 per cent and is absent in 20 per cent. If the leg is extended it may have to be flexed before the mobility can be

## TRAUMATIC LUXATION OF THE HEAD OF THE FIBULA

detected Bennet, of Dublin, has pointed out that occasionally the upper end of the fibula does not reach the facet on the tibia. This anatomical fact is to be kept in mind.

*Treatment*—In the majority of the cases reduction is readily accomplished by direct pressure, the knee being flexed to neutralize the pull of the biceps. Spontaneous reduction occurred in three cases, in eleven cases replacement took place during the anæsthetic struggles. Forcible traction and manipulation of the foot is required for some of the double dislocations. In Boyer's case reduction of the outward dislocation of the foot automatically reduced the dislocation of the head of the fibula. Fixation is accomplished by suitable retentive dressing left in place for four to seven weeks. The retentive dressings vary from Cooper's encircling strap and buckle to the incasement of the leg and knee in plaster-of-Paris. Although reduction as a rule is easy, a few cases may require operative interference either to accomplish the reduction or to maintain it. This latter class includes the recurrent cases, old unrecognized displacements giving rise to disability and the acute cases in which the anatomical or pathological conditions preclude a fixation by conservative means. There are four recorded cases of operation, Stimson's, Cotton's and Lyle's. All four gave perfect end results. In Stimson's case reduction could not be accomplished until an arthrotomy had been performed. In Cotton's first case an erosion of the joint with temporary spiking was employed, in the second an erosion with fixation by a fascia lata suture. In the author's case a simple arthrodosis was performed. It is interesting to note that the cases requiring operative fixation were all posterior dislocations. The flat joint surface, combined with the strong posterior pull of the biceps, are undoubtedly factors in keeping up this dislocation.

*Prognosis*—Conservative treatment gives excellent anatomical and functional results, occasionally a weakness develops when the biceps is brought into strong action. An accompanying recurrent local synovitis or an associated synovitis of the knee may give rise to considerable weakness and fatigue in walking. In two cases the lesion was complicated by paralytic drop-foot. In Oldbriht's and B. Cooper's cases of neglected backward displacement, the dislocation was readily reduced, but could not be maintained. Although only a slight weakness developed in Ericksen's case, a permanent backward displacement, the patient was unable to jump.

The complications arising in the backward displacement, *ie*, the difficulty of retention after reduction, and the paralysis resulting from damage to the external popliteal nerve, show the posterior dislocation to be a more serious lesion than the anterior.

**CONCLUSIONS** 1 Simple traumatic dislocations of the superior tibio-fibular joints are rare.

2 The forward dislocation is the most frequent, the posterior the most serious.

3 Reduction and immobilization are readily accomplished.

4 A few cases require operative interference.

## CASE REPORTS

CASE I—*Posterior dislocation of the superior tibio-fibular joint of eighteen months' standing Arthrodesis—cure* The patient a healthy male, aged twenty-two, was referred to Doctor Lyle's service at St Luke's Hospital by Dr A H Dugdale, the diagnosis being posterior dislocation of the head of the fibula Eighteen months previously his left knee was caught between a moving planing bench and a heavy barrel He experienced considerable pain on the outside of the knee and although he could move his knee, the pain prevented him from walking He was conscious of a movable bone on the outer side of his knee The condition was diagnosed as a posterior dislocation of the head of the fibula and confirmed by X-ray examination The dislocation was reduced and the leg immobilized in plaster Each time the plaster was removed the dislocation recurred On July 9, 1924 he entered the hospital for an arthrodesis His chief complaint being pain and weakness of the knee Examination shows a typical posterior dislocation of the head of the fibula, there is a moderate range of mobility which is accompanied by pain A mild degree of synovitis is present X-ray examination shows a moderate degree of separation of the upper ends of the tibia and fibula Operation July 11, 1924 Arthrodesis of the upper left tibio-fibular articulation

*Pathological Findings*—The ligaments binding the head of the fibula to the tibia were ruptured allowing a free motion of the fibula on the tibia Operative procedure Cartilage removed from both joint surfaces, the surfaces were approximated and capsule sutured with the leg flexed at the knee and a plaster case applied The patient made an uneventful convalescence the case being removed at the end of six weeks Examination ten months after the operation shows a firm fibrous ankylosis

CASE II—*Posterior dislocation of the head of the fibula complicated by a paralytic drop-foot* Six months previously the patient, a boy aged sixteen years, while playing football, was kicked on the outside of the knee, he felt something snap and fell to the ground Although he could move his knee, he could not stand or walk on account of the pain A diagnosis of dislocation of the head of the fibula was made by his doctor and confirmed by X-ray examination The dislocation was reduced by the school doctor and the leg immobilized in plaster On removing the case, six weeks later it was noticed that the patient had a drop-foot this condition gradually improved until two months ago, since then it has remained stationary He now comes for advice regarding the paralytic drop-foot

## BIBLIOGRAPHY

- Boyer Quoted by Malgaigne Traite des Maladies Chirurgicales, vol III, 5th ed  
 Bryant, T Surgery, Phil 1881, 3rd Am Ed, pp 807 and 934  
 Cooper, A Cooper and Travers Surgical Essays London, 1819 pt II, p 94  
 Cooper B A Treatise on Dislocations and Fractures of Joints with Additional Observations and Memoirs by Author Phil, 1884, p 199  
 Cotton, F J Dislocations and Joint Fractures, 2nd ed, Phil, 1924 Saunders and Co, p 599  
 Dubreuil Luxation de la tete du perone Jour Soc de Med Pract de Montpellier 1844, vol IX, p 112, Jour de Chirurgie, 1844, p 214  
 Emmert Pract Handbuch der Chir, 1867, vol IV, p 400  
 Erickson, J E Surgery Am ed, 1878, 7th ed, vol 1, p 509  
 Fenwick, P C Congenital Subluxation of the Head of the Fibula British Med Jour, 1898, vol II, p 1061  
 Ferguson, R T Dislocation of the Head of the Fibula by Muscular Action British Med Jour, 1899, vol 1, p 1214  
 Fishbourne, J E Dislocation of the Head of the Fibula Forward and Upwards Brit Med Jour, 1887, vol 1, p 617  
 Foucher Luxation de l'extremite superieure du perone avec fracture des tibia Gaz des Hop, 1866, No 49, p 193

## TRAUMATIC LUXATION OF THE HEAD OF THE FIBULA

- Golley, F B Report of a Case of Dislocation of the Upper End of the Fibula Amer Jour Surg, 1907, vol xxi, p 171
- Hawley Quoted by Hamilton, Fractures and Luxations, Phil, 1880, 6th ed, p 843
- Hirschberg, K Die Luxation der Fibula Arch f klin Chir, 1888, vol xxxvii, p 199, Literature
- Jobard Gaz de Strassbourg, 1853, vol vii
- Klose Ein Fall von traumatisches Luxation der Fibula im oberen Tibio-fibular Gelenk Deut Militärzt Zeitschr, 1913, vol xlii, p 911, illustrated
- Leggett, A Dislocation of the Head of the Fibula Lancet, 1888, vol 1, p 620
- Lyle, H H M Two Cases of Dislocation of Superior Tibio-fibular Joint Occurring in Amputation Stumps Demonstrated before the Clinical Congress of the A C S, St Luke's Hospital, October, 1923
- Melzer, A Zer Kasuistik der Verrenkungen des oberen Tibio-fibular Gelenkes Allgem Militärzt Zeitung, 1871, vol xii, No 21, p 140
- Oldbright, W Luxation of Head of Fibula Canada Jour Med Science 1881, vol vi, p 79
- Parkinson, J H Simple Dislocation of the Fibula N Y Med Record, 1886, vol xxi, p 442
- Pillard, E Essai sur l'étiologie des luxations de l'articulation péronéo-tibiale supérieure These de Paris, 1872
- Read, T B Dislocation of the Head of the Fibula Forward and Outward (Phil) Med News, 1883, vol xli, p 241
- Richardson, T G Luxation of the Head of the Fibula Amer Jour Med Sc, 1863, vol xlv, p 385
- Robert Observations de luxation simple de l'articulation pernéo-tibiale supérieure Mem de Med Militaire, 1878, No 3 Recueil de Mem de Med Clin et Pharm Militaires, 1879, vol xxxv, p 279
- Rosenberry, H L A Rare Dislocation Med and Surg Reporter, Phil, 1887, vol lvii, p 333
- Sanson See Nelaton's Eléments de Pathologie Externe, 2nd ed Paris, 1874, vol iii, p 285 (This is the Oldest Recorded Case)
- Savournin Reported by Goyarand Rev Med Chirurgie, Oct, 1853
- Shaw Relative Position of the Fractures in Nineteen Specimens of United Fractures of the Bones of the Leg Trans Pathol Soc, London, 1848, vol 1, p 125
- Sorbets, L Luxation de l'extremite superieure du perone gauche Gaz des Hôpit, 1868, vol xli, p 279
- Stimson, L A 1 A Treatise on Dislocations Phil, 1888, Chap XXX, p 503 2 Two Rare Dislocations Dislocation of the Upper End of the Fibula, Outward and Forward N Y Med Jour, May 25, 1889, vol xli, p 561 3 N Y Med Journal, Feb 6, 1892 4 Fractures and Dislocations N Y and Phil, 1912, 7th ed, Lea and Febiger, p 885
- Stoll Verrenkung der obern Endes des Wadenbeins nach oben Med Corresp Blatt d Wurttenburg Arzt Ver Stuttgart, 1851, vol xxi, p 300
- Stromeyer Quoted by Reichel System Pract Surg v Bergman, Bruns and Mikulicz, Phil, 1904, Lea Bros, vol iii, p 681
- Thomson, H A Peculiar Case of Dislocation Lancet, 1850, vol 1, p 385
- Tillaux Rapport oral sur un fait de luxation simple de l'articulation perineo-tibiale superieure qu' a adresse M Michel Bull de Soc de Chir, 1879, No 8, p 709
- Vaccari C Archivio Italiano di Chirurgia, vol viii, Jan 6, 1924, pp 658-664

# THE EFFICIENCY AND INEFFICIENCY OF CERTAIN SKIN ANTISEPTICS†

By MARTIN B. TINKER, M.D.

AND

H. B. SUTTON, M.D.

OF ITHACA, N. Y.

THE problem of infection in the so-called "clean case" presents itself at intervals in every hospital. At such times, sponges, towels, sterilizers, etc., are investigated rigidly and little thought is ordinarily paid to the most frequent source of trouble, the method of preparing the skin of the patient. The antiseptic technic of the average hospital is considered by its staff as standardized, practically infallible, and is subject to little change. Estimates of the value of antiseptic methods are generally based on laboratory experience under conditions very unlike the clinical conditions which obtain in the operating room or hospital ward, and surgeons who carefully follow wound-healing almost invariably report occasional infections following clean operations. The efficiency of widely-used skin disinfection methods under certain conditions early impressed us during bacteriological laboratory tests used in teaching medical students the principles of surgery. These methods were outlined by Obendorff, *American Medicine*, 1906, vol. xi, p. 405, further emphasized in a later paper (*Journal of the American Medical Association* 1910, vol. lv pp. 1430-34), and the fallacies of the then popular iodine methods were specially studied (*Surgery, Gynecology and Obstetrics*, June, 1911, p. 530). The selective action of certain antiseptics for certain bacteria was recognized in these earlier studies when plate cultures of anthrax were seen to leave a wide, clear zone around metallic silver while *B. pyocyaneus* grew almost up to the silver. The importance of selective action was not then appreciated, but recent studies indicate its importance with a re-study of methods of skin disinfection. Several fundamental questions other than those pertaining to selective action of bacteria seem still relatively unsettled and of sufficient interest and importance to deserve further study. For the sake of clearness we have stated these as follows:

In what percentage of cases are bacteria present on or in the skin of protected areas of the body? Is the hernial area more frequently contaminated than the breast?

How efficient is the ordinary soap and water scrub in freeing the skin from bacteria?

How efficient is hospital ward preparation?

How efficient are various antiseptics in the presence of blood?

How important is the element of time? What is the efficiency of our various antiseptics with resistant bacteria if spores be given time to germinate?

---

† Read before the American Surgical Association May 6, 1925.

## EFFICIENCY OF SKIN ANTISEPTICS

What of the selective action of various antiseptics? Are some of the recently studied dyes more efficient in dealing with certain resistant bacteria than other hitherto more commonly-used agents?

In this study of these questions over 1200 laboratory tests were made, a group of Cornell Medical students and pupil nurses from Ithaca City Hospital donated the use of their skins, Doctor Goldberg, Pathologist, and Miss Masterson, Technician of the Ithaca City Hospital, contributed freely of their time, most important of all, the facilities of the bacteriological laboratory of Cornell University were put at our disposal by the Director, Dr V A Moore, and his associates, who also gave us most valuable advice and help

The methods used and results obtained were as follows

*Skin of Protected Areas*—Tests were made by Miss Masterson, Technician of the Laboratory The skin of the inguinal and breast region of twenty pupil nurses was tested no special preparation as to cleanliness or disinfection was made The skin was moistened with sterile water and scrapings made down to the true skin with a scalpel which had been thoroughly flamed, scrapings were transferred by a platinum loop to agar slants and broth Six of twenty-two cultures from the inguinal region and four of twenty-one cultures from the breast region were found free from growth This is contrary to general teaching, that the deeper layers of the skin always contain bacteria, and that the inguinal region is more likely to be contaminated than the breast

*The Efficiency of Soap and Water Scrub*—Areas of two inches in diameter were smeared with broth cultures of the resistant spore-forming B Subtilis and allowed to dry well They were then scrubbed with gauze and soap and water for two minutes and scrapings were made and cultured as above Thirty per cent showed no growth

These two groups of tests apparently show that the absence of bacteria on or on the skin generally attributed to the use of antiseptics may be from ordinary cleanliness or the use of the simplest mechanical and cleansing agents

*Efficiency of Ward Skin Preparation*—Preparation for routine hospital operations was made with soap and water scrub, followed by ether, 95 per cent alcohol, and mercuric chloride solution 1:1000 and an additional swabbing with ether on the operating table Skin scrapings were taken as detailed above and gave 75 per cent no growth in fifty-eight instances Although the number of growths were very few and the number of colonies did not exceed three in any case, the fact that the bacteria are occasionally present after hospital ward preparation indicated the importance of a further final preparation on the operating table

In previous series of experiments to test the efficiency of various antiseptics in skin disinfection, the skin was smeared with bouillon cultures of non-pathogenic bacteria and the methods of disinfection were carried out precisely as they would be in the operating room or hospital ward Recent observations on the selective action of certain antiseptics for certain groups of bacteria have made it seem necessary that each antiseptic which we pro-



pose to use be tried individually with all the bacteria which it might under any circumstances be necessary to kill. It would be obviously dangerous to use virulent, disease-producing bacteria on the skin of any one. Hence the following method was used, suggested by experiments made to test the value of rinsing the gloved hands in antiseptic solutions, as is commonly done in most operating rooms. Strips cut from discarded rubber gloves were dipped into each culture, allowed to dry, then dipped into the antiseptic solution which it was desired to test. It was found that with certain bacteria and certain solutions the rubber strips were uniformly free from contamination. In other cases, with other germs or with other antiseptics the strips were frequently, or in some cases, uniformly contaminated. It is obvious that if bacteria are not killed on this smooth rubber surface with perfect contact, it would be unreasonable to expect them to be destroyed under conditions requiring penetration and imperfect contact.

*The Effect of the Presence of Blood on the Efficiency of Antiseptics*—Blood was used in the culture media in studying streptococcus hæmolyticus only and with blood present in the media was it found as difficult to kill as some of the supposedly very resistant spore-forming organisms. It would be interesting to test the effect of blood with cultures of other organisms, but time did not permit with this series of tests. With plain broth, streptococcus hæmolyticus proved as easy to kill as staphylococcus albus, all antiseptics proving effective while with blood in the media only the dyes and picric acid (See Table) were found efficient.

*Efficiency as Related to Preventing the Germination of Spores*—Cultures of certain spore-formers were kept under observation in the incubator for five weeks without the appearance of any growth so it seems fair to assume that spores are killed by some of the antiseptics. The special organisms and antiseptics are shown in the accompanying table.

*Selective Value of Antiseptics*—The selective action of certain dyes was strikingly shown: some infallibly killed resistant spore-forming bacteria, while others failed to kill even the relatively non-resistant *B. coli communis*. (See Table.) Churchman has made several valuable contributions to this subject, during the past four years, calling attention, for example, to the fact that *B. pyocyaneus* is killed by acid fuchsin, one of the less efficient dyes, while this germ resists practically every ordinary antiseptic which we have tried, except five per cent alcoholic acriflavine solution. Probably it is only by use of combinations of several antiseptics that efficient skin disinfection can be attained.

*Is One Hundred Per cent Efficiency of Disinfection Possible?*—Thus far among many commonly-used antiseptics only chlorinated lime paste killed anthrax spores under clinical conditions and in the length of time which would be ordinarily practical in surgery. Anthrax spores are fortunately seldom present on the skin of patients. There can be no doubt that efficiency of skin disinfection could be greatly increased by careful ward and operating room preparation followed by the use of the combination of some of the more

# EFFICIENCY OF SKIN ANTISEPTICS

efficient antiseptics, probably especially the dyes The present cost of the dyes is prohibitive, so far as use in the strength necessary for rapid effect and in the quantities ordinarily employed are concerned However, it is possible by careful use with a small swab to make one-half ounce of 5 per cent acriflavine solution cover the average skin area needing preparation This

TABLE I

	Subtilis	Staph albus	Staph aureus	B coli	Strep hem blood broth culture	Strep hem broth culture	B Pyocyaneus	Anthrax vegetative	Anthrax spores	Tetanus	Welch
Alcoholic Iodine, 5%	■ 100	○	○	○	■ 100	○	■ 66	■ 33	■ 100	○	○
Benzine Iodine, 5%	■ 100	○	○	○	■ 75	○	■ 100	■ 33	■ 100	■ 66	■ 33
Picric Acid 5% in 95% alcohol	■ 100	○	■ 50	○	○	○	■ 66	■ 100	■ 100	○	■ 33
Harrington's Solution	■ 21	○	○	○	■ 100	○	■ 33	○	■ 100	■ 75	○
Mercurochrome 5% in 50% alcohol	■ 90	○	○	○	■ 75	○	■ 66	○	■ 100	■ 66	■ 33
Acriflavine 5% in 50% alcohol	○	○	○	○	○	○	○	○	■ 100	○	○
Acriviolet 1% aqueous	■ 50	○	○	■ 100	○	○	■ 100	○	■ 100	○	■ 100
Acriviolet 2% in 50% alcohol	○	○	○	■ 25	○	○	50	○	■ 100	○	■ 100
Figure	I	II	III	IV	V	VI	VII	VIII	IX	X	XI

Table shows the effect of contact of antiseptic with bacteria for three minutes If two or three antiseptics are used in order to get selective action this will consume as much of the fifteen to twenty minutes usually devoted to skin disinfection as is ordinarily available The circles indicate no growth, black squares, growth and figures underneath, percentage in which growth occurred

one-half ounce of solution would represent the cost of several gallons of the ordinarily-used antiseptic solution In many previous tests, Harrington's solution, double strength, has given very efficient results, much more so than in this series It is possible that the bacteria used in this series have been more than ordinarily resistant

Churchman's observations on communal activity of bacteria show that single organisms, motile, resistant strain of B coli or small groups of this organism up to 30, do not grow in very dilute gentian violet broth, or on gentian violet slants, but do grow if larger numbers of bacteria are present This suggests the possibility that similar conditions may obtain with other bacteria In such case if the number of bacteria can be reduced to only

three, which was the maximum found after our ordinary ward skin preparation, it is possible, that the dyes would be efficient in low enough dilutions and consequent lower cost, to make their use available for the average hospital.

In estimating the efficiency of antiseptics for surgical use several considerations enter in beside the efficiency in killing bacteria: time of action, cost, simplicity in use, cleanness in outlining the field of operation, damage to supplies and the patients' tissues.

Time is an important element in the operating room, not only as concerns the surgeon and his staff, but especially in dealing with very ill patients. The antiseptic under consideration should be efficient in the five to ten minutes' time ordinarily available in the operating room. Few operating rooms will devote much more time than that to skin preparation. The antiseptics shown were tested for periods of two to five minutes, three minutes being considered the standard, which was tabulated.

Cost must be considered in most hospitals. The antiseptic under investigation should be readily available in amounts necessary and at reasonable cost. Among the efficient antiseptics the dyes are at present prohibitive in cost. Chlorinated lime paste is not shown in the table, but has been found in previous tests as well as a limited number in the present series to be most efficient and is extremely low in cost, as is also Harrington's solution.

Cleanness and accuracy in outlining the field being prepared has no doubt influenced the widespread use of picric acid and the iodine preparations. Apparently other more efficient antiseptics are available which outline the field equally well, and make certain that all is adequately covered. The dyes, especially acriflavine, have this advantage. Recently we have added a small amount of acid fuchsin to Harrington's solution in order to outline its application.

Simplicity of technic is very important. The antiseptic employed should give dependable results in the hands of relatively untrained pupils, nurses and interns.

Damage to instruments and materials is also important. We have to consider the corrosive action of certain mercurial antiseptics on instruments and apparatus, and the holes frequently eaten in protective sheets, towels, and operating gowns by the chlorine antiseptics and Harrington's solution in estimating their usefulness.

Damage to the patients' tissues is a most important consideration. The antiseptic should not cause blistering or raw skin, intestinal adhesions, delayed wound-healing, or any other of a number of disadvantages of certain commonly-used antiseptics. Iodine has been discarded by many surgeons for these reasons alone. The dyes are found by some to delay wound-healing, but probably not when only used on the skin.

Clean wound-healing is the most important consideration. *Will the antiseptic kill all germs* which might by any possibility be present, and *under all conditions?* If not, is it possible to find a combination of antiseptics which

## EFFICIENCY OF SKIN ANTISEPTICS

will prove efficient? The table shows our results and to this should be added that we have found fresh chlorinated lime paste is always efficient

### CONCLUSIONS

1 The superficial and deeper layers of the skin of protected areas in cleanly individuals are frequently free from bacteria

2 If the skin be smeared with resistant non-pathogenic bacteria, soap and water scrub alone for two minutes will make it free from bacteria in 30 per cent of cases

3 Careful ward preparation with ether swab on the operating table is capable of giving skin free from bacteria in 75 per cent of cases, and of reducing the colonies in the remainder to a maximum of three

4 The selective action of antiseptics is so important that it seems wiser not to depend upon any single antiseptic for skin preparation

5 Iodine preparations, picric acid, and alcohol alone which seem still to be the chief reliance in a number of hospitals, are too inefficient under ordinary clinical conditions to be depended upon for routine skin disinfection

6 Acriflavine 5 per cent proved most efficient in this series of tests, but probably its use combined with other dyes and antiseptics might be desirable. The chief drawback to the use of the dyes is their almost prohibitive cost

7 It would probably be safer not to discard altogether the use of some of the older relatively efficient antiseptics until those used to supplant them have been given thorough clinical as well as laboratory tests in a number of hospitals

# TRANSACTIONS

## OF THE

### NEW YORK SURGICAL SOCIETY

*Stated Meeting Held March 11, 1925*

The President, DR EUGENE H POOL, in the Chair

#### GALL-BLADDER DISEASE IN EARLY LIFE

DR EDWARD D TRUESDELL presented a woman, who being twenty years of age was admitted to St Luke's, September 5, 1924. There was a five months' history of attacks of epigastric pain, nausea and vomiting. These symptoms were relieved by vomiting. There had been a period of two weeks of jaundice. She was brought to the hospital by a more severe attack of pain than usual, with a slight return of the jaundice. She had been married two years and had borne a child at term. *The physical examination* was negative but for slight localized tenderness over the gall-bladder. The jaundice complained of was not apparent. *At operation* the gall-bladder wall was found to be greatly thickened, the common-bile duct was dilated, the entire pancreas was greatly thickened and indurated. *Operation* consisted in the removal of the gall-bladder, with drainage of the common duct. As the common duct could not be entered through the cystic duct on exploration the former was incised in its course through the gastro-hepatic omentum and a small soft rubber tube inserted. The recovery was entirely uneventful.

The patient is presented to show an advanced degree of gall-bladder disease, with dilation of the common bile duct and a chronic pancreatitis in a young woman in her twenty-first year.

In a series of 47 successive cholecystectomies for cholecystitis associated with cholelithiasis, including the present case, 11 were in patients giving their ages as 30 or under. Of these 11, 2 were 20, 2 were 23, 1 was 27, 2 were 29, and 4 were 30 years of age.

These facts offer further evidence in favor of the belief that gall-bladder disease not uncommonly has its inception in the latter part of the second decade of life.

DR EDWARD W PETERSON said that he had shown before the surgical section of the Academy, a boy eight years of age with acute cholecystitis, and had reported the case of a fifteen-year-old girl with an infected gall-bladder with a number of stones. Rolleston reports gall-stones in the newborn.

DR HOWARD LILIENHAL referred to a case which he had reported before this society a number of years ago. The patient was a girl of eleven upon whom he performed cholecystectomy, finding numerous pigment stones in the gall-bladder. Many years later she died of pernicious anæmia. Dr A A Epstein suggested that blood abnormality may have had something to do with the throwing down of pigment in a possibly infected gall-bladder.

#### ACUTE TORSION OF THE FALLOPIAN TUBE

DR EDWARD D TRUESDELL presented a woman, age thirty-six who was admitted to St Luke's Hospital for the repair of a lacerated cervix and perineum. Pre-operative pelvic examination failed to reveal abnormalities.

## ACTINOMYCOSIS TREATED BY IODIDE IONIZATION

other than the laceration of the cervix and a well-marked rectocele, as did the examination under anaesthesia. The cervix and perineum were repaired July 15, 1924. The three days following operation were uneventful. On the fourth day the patient complained of cramp-like abdominal pains. There was no vomiting; the bowels were moved by enema. On the fifth day the pain had become localized in the right lower quadrant, the temperature was  $101^{\circ}$ , the leucocytes were 15,400, with 88 per cent polymorphonuclears, and an acutely tender mass was felt beneath moderate rigidity occupying the right lower quadrant. Upon opening the abdomen through a McBurney incision a slate-colored cystic tumor was found occupying the iliac fossa. An enlargement of the incision was necessary to deliver the tumor which was then found to be a greatly distended Fallopian tube, that had become strangulated by one or more turns at its broad ligament attachment which formed its axis. The ovary was normal. The tube was removed, as was the appendix, which was normal. The subsequent course was entirely uneventful, the patient leaving the hospital on schedule time.

The patient is presented to show an unusual complication of a common operation. There was no evidence of preexisting disease of the uterine adnexa. It is possible that sympathetic muscular activity of the tube coincident with overactive intestinal peristalsis may have brought about acute torsion of the tube.

## ACTINOMYCOSIS TREATED BY POTASSIUM IODIDE IONIZATION

DR. HOWARD LILIENTHAL presented a man, aged forty-eight, who was his patient about thirty years ago. At that time he suffered from a peculiar form of subcutaneous infection of the left forearm which gradually extended to the shoulder, in spite of many operations at which the tissues were laid wide open. Eventually there was an osteomyelitis of the ulna. The radius also became involved. It was several years before final healing took place under ordinary surgical treatment.

At that time numerous attempts were made to isolate the organism causing the infection but were unsuccessful, the usual bacteria of inflammation being the only ones found. He remained well until less than a year ago, when he began to suffer from renal colic. X-ray pictures demonstrated a stone in the lower left ureter. A dentist suggested that his renal colic might in some way be dependent upon a tooth infection. X-ray examination showed a rarefaction at the root of the second right lower molar and following the dentist's advice the tooth was extracted. There followed a suppuration beneath the jaw. The wound in the mouth healed in due time, but the submaxillary infection became so severe that a wide incision was made by another surgeon. The discharge, while purulent, did not entirely account for the swelling which was present. Healing was slow and at last another superficial reddened and fluctuating area close to the wound appeared. This was incised and packed. He was seen first by the reporter in September and from a little incision which had to be made on account of another superficial abscess, there was obtained material which was sent to Doctor Mandlebaum for confirmation of a provisional diagnosis of actinomycosis, which was made on account of the characteristic "lumpy jaw" and the fact that no dead bone could be demonstrated. The pathologist at once reported positive actinomycosis. Treatment was begun with potassium iodide internally and packed with gauze in the wound. Healing was rapid, but as soon as the wound was entirely closed swelling reappeared. The local treatment by potassium iodide had been stopped when the wound was healed. Then it occurred to the reporter that ionization with potassium iodide promised to

carry the iodine ions into the region in greater concentration than could be produced by systemic exhibition. The patient during this time had become naturally somewhat nervous, and hearing of some of the good effects reported after the administration of amsphenamine, he wished to try this in addition to his other treatment. Dr. David Kaliski carried out this treatment, although he stated that the reports had been conflicting, and he did not care to ascribe any possible improvement to this drug alone. The man was sent to Dr. M. L. Rhein for treatment by ionization with potassium iodide. The swelling rapidly receded, the tissues which had been indurated became soft and an apparently full recovery has followed.

Whether this method is applicable to actinomycosis of the internal organs, such as the lung, it is difficult to determine, as well as the method of its application. In a case of mediastinal or pulmonary actinomycosis, it would be a problem whether to lay bare the diseased part and treat it directly or to attempt the ionization through the unopened skin. This case is reported merely as suggestive.

#### CICATRICIAL STRICTURE OF THE ŒSOPHAGUS

CASE I—DR. NATHAN W. GREEN presented a girl, three and one-half years of age, who was admitted to St. Luke's Hospital, November 3, 1921. Her chief complaint was vomiting of mucus and inability to swallow during six weeks previous to admission.

She gave the history of having swallowed some "Sani Fluid Disinfectant" (lye, creosote, etc.), three and one-half months previous to admission. For the next ten days she did not swallow anything. After the burn healed she was able to take liquids and soft solids.

November 8, 1921, under ether, using a small œsophagoscope, a stricture of a lumen of 4 mm. midway in the œsophagus was found by Doctor Green. The instrument could pass no further, but a small bougie 3 mm. in diameter passed and met resistance at the epicardia 6 cm. lower. By very gentle pressure through the 'scope, the olivary bougie was passed into the stomach. This was followed by a blunt bougie 4 mm. in diameter, which also was advanced through the tube into the stomach. (The space of the œsophagus between the two strictures appeared atrophic with small circular ridges.) Leiche's dilator was then introduced into the stomach and opened carefully to 30 F., using very little force and very slow speed. There was considerable bleeding. Both strictures were thus dilated with the intervening space.

December 1, 1921, a similar procedure was carried out. The 'scope showing the œsophagus to be a little more viable. The Leiche's instrument was then opened to 36 F. and then after withdrawing it an olivary bougie 36 F. was passed. This engaged tightly and was slowly passed into the stomach. She was discharged December 19, 1921, but was readmitted March 9, 1922, complaining of the same symptoms, and on March 11, 1922, and March 23, 1922, through an œsophagoscope the stricture was again dilated. Then April 4, 1922, through the 'scope the strictured portion was again dilated, this time to 50 of the Lerche instrument. (This equals about a 46 F. blunt-pointed bougie.) Then a 36 F. bougie passed easily into the stomach. All fluids were withheld for eight hours, then small doses of water were given. The temperature the following day rose to 100° F., but promptly dropped to normal.

She was discharged April 9, to be readmitted on October 11, 1922. Bougies were passed in the interim every two weeks and readmission was made because the bougies could not pass as readily as they should.

October 12, 1922, the 'scope was passed and the œsophagus again inspected and dilated. Bougies were then passed more frequently and the child dis-

## LUNG SUPPURATION

charged October 31, 1922 in excellent condition Since then she has had a bougie passed approximately every month

This case is shown to illustrate the feasibility of controlling benign strictures, which are not impervious entirely through the mouth and without the necessity of a gastrostomy

DOCTOR GRELN presented also a woman, aged nineteen years who was admitted to St Luke's Hospital, July 19 1922 Her chief complaint was inability to swallow Five weeks before admission she swallowed by mistake a small mouthful of concentrated nitric acid Immediately after this she was given milk to drink and within one-quarter of an hour her stomach was washed Three days later the mucous membrane of her mouth "peeled" She was unable to swallow for five days, but after that took fluids slowly, but no solids nor semi-solids In the few days just preceding admission she had great trouble in getting fluids down A roentgenogram taken by Doctor LeWald July 18, 1922, before admission, showed delay in the upper portion of the œsophagus

July 20, 1922, a small œsophagoscope was passed It encountered resistance a little below the upper sphincter of the œsophagus A bougie was passed through this and the 'scope advanced further A bougie was then passed to a length of eleven inches The œsophagus was very red and bled easily in places It had the appearance of a granulated surface She was discharged July 22, 1922, to return the following week for further dilatation She was readmitted July 25, 1922, somewhat improved but not yet swallowing semi-solids

July 26, 1922, she had a gastrostomy performed by Doctor Green under local anæsthesia The Stamm-Kader type was used August 18, 1922, under ether anæsthesia, the Abbe string-sawing operation for stricture of the œsophagus was done and the œsophagus was opened up to a 38 F bougie After this the gastrostomy was kept open for further use until sufficient dilatation should have been accomplished

August 25, 1922 this procedure was again gone through, dilating the œsophagus yet more Only a whiff of ether was necessary during this operative procedure She was discharged August 24, 1922, very much improved and swallowing easily After this the gastrostomy was allowed to heal and bougie dilatations were instituted At first three times a week, then once a week, and later once a month, and now about every two months

She is well, has gained weight, and can readily perform her daily duties

In this case it was necessary to do a gastrostomy on account of the impervious condition of the stricture to instrumentation orally

## LUNG SUPPURATION

DR NATHAN W GRELN presented a man aged fifty years, admitted to St Luke's Hospital, November 22, 1924, with a diagnosis of appendix abscess His chief complaint was pain in the abdomen for two weeks He was operated on by Doctor Schley, December 4, 1924 under ether anæsthesia The appendix was found retrocæcal and surrounded by recent and very friable inflammatory tissue It was removed

January 2, 1925 a bedside note was made stating that the patient coughed a good deal at one time during the previous night The following night he had profuse diaphoresis and that day, January 3 1925 went to the X-ray room He apparently coughed until January 11 when the bedside note stated that the mucus expelled had a foul odor

The report of the X-ray as of January 3 1925, indicated a fairly large



cavity in the upper lobe of the right lung On the same day his temperature ranged between  $101\frac{2}{5}^{\circ}$  to  $102\frac{3}{5}^{\circ}$  F

January 16 it reached  $103\frac{3}{5}^{\circ}$  F, touching  $102^{\circ}$  twice on January 20 He was operated upon under local anæsthesia on January 21, 1925 His temperature did not go above  $101^{\circ}$  but once till the time of his discharge from the ward This exception was after the second stage of the operation for lung suppuration Then it reached  $101\frac{2}{5}^{\circ}$  F

He was discharged to the Out-patient Department for care twenty days after the first stage and twelve days after the second stage of his operation for lung abscess with a temperature of  $98^{\circ}$ , pulse 80, and respiration 20

At operation on January 21, 1925 under local anæsthesia, the first stage of the operation for lung abscess was done A mid-axillary incision was made extending down from the apex of the axilla for four inches The second and third ribs were resected for three inches The parietal pleura was stripped from the under side of the ribs and this was pushed inward by packing down on it with iodoform gauze, thereby compressing the upper lobe of the lung to some degree

At the second stage the parietal pleura was opened It was then firmly adherent to the visceral pleura The lung abscess was explored by first inserting a needle and obtaining pus By passing a grooved director down on the needle and stretching the tissues the abscess was opened Then the opening was enlarged by stretching with dressing forceps The interior of the cavity was then explored by the index finger and found to be about 5 cm in diameter A double rubber tube was inserted directly into the cavity and held in place by gauze packing His Wassermann was negative Since being discharged from the ward (one month ago) he has gained over twenty pounds, "is spitting very little and has but a moderate drainage sinus He was shown to illustrate the method and the ease of approach under local anæsthesia

DOCTOR GREEN presented also a boy, aged fourteen years, who was admitted to the Surgical Service of St Luke's Hospital (Division A) May 17, 1920 His chief complaint was a cough and expectoration of purulent material for nine years At the age of five the patient had a severe case of whooping cough with relapse, following which he began to have a persistent cough Since he can remember he has coughed only at intervals, three or four times a day Cough is usually brought on by a change of posture

Upon examination of his thorax, the left lung appeared normal throughout The right lung showed dullness and diminished voice and breath sounds with decreased fremitus over the right base posterior and laterally After repeated bronchoscopy and X-ray and readmissions his right chest was explored by opening in the intercostal space and spreading the sixth and seventh ribs

September 9, 1920, the first operation was done by Doctor Green Exploratory of the right pleural cavity The lower lobe was found collapsed and no crepitation present There were a few adhesions Ribs were not resected The lower lobe was sutured to the chest wall Some pus escaped during the suturing by the stitches A drain was placed into the dead space below the lower lobe

The second operation was done September 28, 1920 It was drainage of the abscess cavity Five inches of the sixth and seventh ribs were resected On returning to the ward he coughed up a rusty steel pin without a head about two inches long He had no recollection of having inhaled this but from appearances it had been in the lung a long time

After repeated discharges and readmissions and X-ray and bronchoscopic

## CHRONIC SUPPURATIVE PYELONEPHRITIS

examinations he was again readmitted July 18 1924, with the following interval history After operation on the bronchiectatic cavity in December 1921, the patient had gradually gained weight up to 145 pounds (his present weight) but about every eight hours he coughs up nearly one-half pint of yellowish-green foul-smelling material, and occasionally he had coughed up a little blood after violent exercise An X-ray taken July 21, 1924, showed a series of bronchiectatic shadows in connection with the lower portion of the expansile area of the chest

July 22, 1924, the first stage of an extra-pleural collapse of the right lower lobe was performed A vertical incision posteriorly was made removing parts of the tenth, ninth eighth and seventh ribs

On August 5, 1924, the second stage was done by an anterior incision more or less vertical, parts of the sixth, seventh, eighth and ninth ribs were removed

September 3, 1924, the third stage of the operation was accomplished By means of an oblique incision over the fifth rib, the removal of the inter-medial portions was effected

His sputum was negative for spirilla and for tubercle bacilli He was discharged fifty-five days after the first stage, forty-one days after the second stage and twelve days after the third stage of the operation He now states that his sputum although not entirely absent, is much less in quantity and the odor is not so offensive He is still supplementing this collapse therapy by postural drainage each day

DR HOWARD LILIENTHAL said as to cases of lung suppuration in which extra-pleural collapse was done, he did not think that this procedure accomplished very much good As a matter of fact, there is a very great difference between the lung collapse method in this condition and that of tuberculosis In the latter the aim is to secure absolute rigidity of the chest wall, for if one can stop the breathing and motion of the ribs on that side the tuberculosis may become arrested But in lung suppuration there is a different state of affairs There must be drainage and in extra-pleural thoracoplasty one will do good only insofar as one can facilitate the drainage The idea is to get air in The two diseases are entirely different and react differently to the same procedure

## CHRONIC SUPPURATIVE PYELONEPHRITIS

DR NATHAN W. GRIEN presented a woman, age fifty-six years, who was admitted to St. Luke's Hospital, June 12, 1922 Her chief complaint was "falling of the womb" for seven months with pain and swelling of the legs For the past seven months she had suffered great fatigue and pain in the small of her back She has had eight children and a breast abscess seventeen years ago Otherwise there was nothing unusual except that she did not walk until six years of age

Upon physical examination she presented the picture of uterine prolapse, but she also had a hard mass in her right side at the level of the umbilicus extending into the right flank Of this more important finding she did not complain A Rontgen examination showed a shadow of irregular density just to the right of the interval between the second and third lumbar vertebra There was also some delay of the opaque feeding in the lower end of the esophagus The esophagus was scoped under local anesthesia by Doctor Green and the mucous membrane appeared to be normal throughout The

cardia was examined and found to be functioning well. No dilatation nor retention of food was present. The roentgenogram also suggested calcification of a tumor mass.

June 22, 1922, Doctor Green made a mid-right rectus incision by which in the right flank and anteriorly was uncovered the tumor which was about as large as a grapefruit, hard to palpate and adherent to the surrounding perirenal fat and to the ascending colon. The kidney was incorporated in this mass. There were a number of hard lymphatic glands in the mesentery of the ascending colon and in the retroperitoneal tissues. At the pylorus an area of scarring was seen, being the remains of an old ulcer. The left kidney was normal. The gall-bladder was small, soft and without obvious pathology. After exploring the abdominal cavity the kidney tumor was removed as follows. The outer leaf of the mesentery of the ascending colon was incised, freeing the retro-peritoneal tumor mass from the adherent perirenal fat. The pedicle of the kidney was then ligated *en masse* and its components separately. The ureter was then cut and ligated. After freeing from the colon, and some necessary repair, the posterior peritoneum was closed. The anterior peritoneum was then closed and the abdominal wound closed without drainage. Healing was per primam. July 8, she was discharged completely healed.

The pathological report was chronic suppurative pyelonephritis with nephrolithiasis. The specimen comprised a kidney  $11 \times 8 \times 6$  cm. A multilobular cystic mass was revealed with no vestige of renal tissue visible. The ureter was not patent. Section showed a large quantity of thick greenish-yellow pus. Since this focal infection was removed she has gained weight, looks ten years younger, and is greatly improved in health. His purpose in presenting this patient was to bring out discussion regarding the advantages of this anterior approach for removal of the kidney. The ease of access to the pedicle by this method was worthy of note.

DR CHARLES H. PECK said he had had a case of a seven months' old baby in which the diagnosis was splenic tumor. At operation the spleen was found to be normal, the mass being a tumor of the left kidney. The abdominal approach was continued for the nephrectomy and the speaker was struck with the ease of the approach and the control of the pedicle. He has always used the posterior route in kidney tumors and usually found it satisfactory, but now feels that the transperitoneal route may be a better method in some cases. The patient made an excellent recovery.

#### BILATERAL MAMMARY CANCERS

DR CLARENCE McWILLIAMS presented a woman, fifty-eight years of age, who was first seen by him in September, 1910, with a walnut-sized tumor in the outer upper quadrant of the left breast. In September, 1910, at the Presbyterian Hospital, this tumor was removed and the frozen section examined, which demonstrated the growth to be carcinoma. A radical removal of the breast with clearing out of the axillary contents was done immediately. Pathological examination of the axillary contents showed no node involvement. Six years later she returned with a small tumor in the outer upper quadrant of the right breast which was removed in April, 1916, the method of procedure being the same as in the previous tumor and the presence of cancer in the tumor having been demonstrated by examination of a frozen section previous to extirpation. Pathological examination showed no carcinomatous involvement, although an enlarged node found in the axilla at the time of operation was demonstrated not to be cancerous. She was presented to instance the

## BILATERAL MAMMARY CANCERS

belief of the author that many of the bilateral mammary cancers are independent primary growths also that local excision of the tumors for frozen section diagnosis is harmless, provided the radical operation be at once performed if cancer is found. This woman is alive without recurrence fifteen years after the first operation and nine years after the second.

The reporter does not think that it is necessary to emphasize that cancer is a local disease in the beginning if radical operation be performed before node involvement. Rodman has shown that 65 per cent will be alive five years after operation for mammary cancer while only 30 per cent will be alive five years after operation if the nodes were involved. The prognosis therefore in any given case depends largely on whether the nodes are involved or not, hence the irrationality of giving pre-operative X-ray treatments before operating in mammary cancer, for by adopting that plan from two to four weeks' time is lost, during which period node involvement may take place, thus diminishing the ultimate prognosis by at least 30 per cent. Such treatment is not based on any scientifically demonstrated facts. This patient has had no X-ray treatments at any time, which illustrated the fact that if the surgeon gets out all cancer cells by his operation, the patient remains well. If not, a fatal result will be inevitable despite all X-ray treatment, the only effect of which can be to delay the fatal outcome.

DR. GEORGE WOOLSFY said that he believed most of the bilateral tumors were recurrences. It has been shown by Kilgore that if a patient has survived five years after removal of the breast for carcinoma, that patient is three or four times more likely to have carcinoma of the other breast than a normal person of the same age. The second breast is infected by permeation of the lymphatics. Judd found in the Mayo Clinic the late involvement of the second breast in 10 to 12 per cent of cases when one breast was removed. As regards radiation, the speaker did not favor pre-operative radiation of cancer of the breast, only post-operative.

DR. JOSEPH WIENER referred to a patient of his from whom he removed a nodule in the breast in 1900. It proved to be adenocarcinoma, and he did a radical removal. Eleven years later she came back with a rapidly growing scirrhous of the opposite breast. Again radical operation was done. This was in 1911. Last year she invited Doctor Wiener to her seventieth birthday party. The speaker did not believe one should consider the scirrhous a recurrence. Bloodgood has stated that if a benign tumor is removed from one breast, any subsequent tumors will not be malignant, Doctor Wiener thought that a dangerous doctrine to promulgate because it does not hold in every case. In regard to radiation, he had never heard that surgeons were in favor of pre-operative radiation. He had been giving radiation post-operatively for seven or eight years, and in every case of carcinoma of the breast that he had removed he has treated the patient himself subsequently. A patient of his developed ulceration of the skin following radiation and the pathologist found dead carcinoma cells killed by radiation.

DR. HOWARD LILIENTHAL said he did not agree with Doctor Wiener's logic that because a few cancer cells are killed after operation that none of them will be killed before. Cancer cells, if under the skin, are hard to kill. He has for the past four years been radiating pre-operatively every case

of carcinoma of the breast He is not prepared to say that the cases did better because of this, for in two there was rapid recurrence in spite of the pre-operative radiation, and he is inclined to think he will give up pre-operative radiation He took it up on account of experiments published abroad, but Francis Carter Wood has changed his opinion Doctor Wood says that the skin takes up so much of the X-ray effects that unless one kills the skin, what is under it will not be killed

### FREE, FULL-THICKNESS SKIN GRAFTS

DR CLARENCE A McWILLIAMS presented a number of patients illustrating the uses of free, full-thickness skin grafts The advantage of these grafts is that there is no subsequent contraction The difference between the free, full-thickness graft and the pedicled graft was in the circulatory system The blood supply of the skin comes from vertical off-shoots from longitudinal vessels in the subcutaneous fat Free grafts get their blood supply by osmosis from the underlying raw base, hence pressure on the graft is essential to make close contact Pedicled grafts get their blood supply from vessels running through the pedicle, hence pressure would obstruct this free blood supply, and consequently is inadvisable As to the technic, the essentials of success in grafting free, full-thickness, non-pedicled grafts are as follows

1 Clean operative wounds are best of all, though sterile granulations are not unfavorable

2 The base must be smooth and best of all muscle or fascia In some cases they have been successful on the skull bones, the dura mater, the periosteum and the tendons, such as the Achilles

3 No fat should be on the under surface of the graft (Davis Blair, New), this being trimmed off with scissors Gillies says that fat on the under surface of the graft makes no difference in its viability (?)

4 The base must be perfectly dry without any oozing

5 There should be just as little handling and pinching of the grafts with the forceps as possible, sharp hooks being used to lift the graft

6 The graft should be perforated in a number of places, to allow the blood or secretions to escape from under them (Davis) In addition these perforations afford an increased means of entry of serum into the graft for its nourishment

7 The graft should be transplanted to its new bed as quickly as possible after its excision, so as not to compromise its nutrition and it is advisable to transfer it dry without immersion in salt solution, to favor more securely its adhesion

8 The most unfavorable base on which to place a free, full-thickness graft is fresh fat, as through this fat very little blood can pass In such a case, the fat should be allowed to granulate before grafting on its surface

9 Gillies makes the point that it is well to put some tension on the graft, equal to that in the position from which it was removed, since this stretching favors easier absorption of serum from the bed, hence the graft should not be cut any larger than the space to be filled

10 Most essential of all is to apply very firm, even pressure on the graft, and to keep the parts absolutely immobile, and not to disturb the dressing for about seven days Davis uses a sea sponge for this purpose

## X-RAY DERMATITIS OF PALMS

11 The epithelial layer of the graft may slough, but this does not injure the deeper skin layers

12 Free, full-thickness grafts, taken from hair-bearing areas, may be successfully transplanted into eyebrow defects, with a subsequently resulting growth of hair in the graft. In such hair-bearing grafts, a very thin layer of fat should be left on the graft since the hair follicles project into the fat.

13 The healthy prepuce, removed by circumcision, portions of the scrotum and the eyelids make very successful free, full-thickness skin grafts, since they do not contain fat.

14 Free, full-thickness grafts should not be cut larger than 3 inches long by  $1\frac{1}{2}$  inches wide. A large area should be covered by such individual segments, each being stretched and sewed in place.

## X-RAY DERMATITIS OF PALMS ABDOMINAL FLAP

DR CLARENCE A. McWILLIAMS presented a woman, of fifty-two years, who shows the deplorable results that can be produced by X-ray treatments. This patient had had an eczema of the hands for six years. Treated by all kinds of dermatological experts without any good results. Two years ago she was subjected to X-ray treatments to each hand, a dozen treatments at intervals of a week. These treatments did no good whatsoever. The itching she had was intolerable. This has increased since and to it has been added an intense burning. The right hand palm is the seat of a chronic indurated dermatitis covered with crusts and scales and cracks extending on fingers and thumb down to second phalangeal joints and to wrist. The right palmar skin is very thick, the result of the X-ray treatments, a regular fibrosis of the skin. This thick skin frequently cracks and is prone to develop carcinoma. In the palm of the left hand there developed an ulcer four months ago. This was clinically diagnosed as cancer and removed by the diathermic knife, but no pathologic examination was made. She was later sent to the reporter for plastic operation to correct the operative sequelae. In the course of this procedure the whole superficial palmar layer was removed, uncovering the tendon sheaths. To cover the raw area a pedicled skin flap was raised from the abdomen, lifting up three sides of the flap and closing the resulting raw area by undermining the edges or failing this by immediately Thielsch grafting the raw area. Thus the secreting raw area is done away with. The disadvantage of the pedicled flap is the fat which one must leave on its under surface to assure its sufficient blood supply. This fat must be removed in a subsequent operation. On this patient's right hand it is proposed to place one large full thickness free graft after removing all the skin.

There is about an 80 per cent chance that it will take. If it does not take, no harm will be done and the defect can then be covered by a pedicle flap from the abdomen. The edges of the flap were then sutured to the edges of the raw area and held to the abdomen by bandage.

On the twelfth day after the previous operation, a clamp was put on compressing one-quarter of the pedicle close to the abdomen. On successive days the clamp was advanced one-quarter of the flap more, until the day before the final operation the clamp was on the whole pedicle for twenty-four hours. The entire flap was then cut away and sutured in position to the remaining edges of the raw area of the hand. The hand was put on a wooden splint. Primary healing throughout followed. The fingers were naturally very stiff and efforts had been made by active and passive motions and baths to limber them up. These efforts are slowly succeeding. Just as soon as they are fully limber the right hand will be attacked removing the thick palmar

skin and covering the defect with a full thickness free skin graft from the abdomen. The chances are that the ulcer on the palm was of the prickly cell variety which will require dissection out of the axillary nodes.

### CARCINOMA OF THE RECTUM AND RECTO-SIGMOID

DR JAMES I RUSSELL read a paper with the above title, for which see *ANNALS OF SURGERY*, May, 1925, vol LXXI, p 972

DR CHARLES H PECK said that in reviewing his own cases of the last ten years, he had found them a very discouraging group because so many of them are in the later stage of the disease when first seen. In his own group of 44 cases he had found an operability of only 50 per cent and he lost 7 out of 22 radical operations. He had tried every method he ever heard of, in the way of technic, and had not settled down to any one method. Cases varied in the extent of the growth and in position. In one group the best method of approach was to first do a laparotomy to determine if there were any secondary nodules and also the extent of the growth and decide on further procedure. In some, he had been able to go ahead with a one-stage operation. In one case in particular, the sigmoid was so long and lax that he was able to do this, making a perineal anus, and the woman is now alive and well, six years after operation. There was no tension and there was ample room to do it. She has pseudo-control because the tissues healed well around the opening, and is very comfortable. In another case he had been able by a combined one-stage operation to invaginate the growth downward through the anus and allow the freed portion to become necrotic. Recovery was satisfactory and the patient left the hospital in good condition but died later from the effect of a stricture at the site of anastomosis. Those cases are the exception. Doctor Peck referred to a case he had seen with Doctor Russell of the smallest carcinoma he had ever observed, it was discovered through the sigmoidoscope. It was hardly bigger than the head of a pin and was difficult to identify as a carcinoma. Radical operation by Doctor Russell was done and the patient is now well, after three and a half years, and has every expectation of being completely cured. If every patient were seen at that stage, the whole group would have a different aspect. One patient in whom carcinoma had been discovered at a very early stage when it was very tiny, had been advised to submit to operation but refused. Two years later he was brought to the hospital with complete obstruction from massive carcinoma and died in twenty-four hours. The life of that case from its earliest manifestation to its ultimate termination was two years. He had another case of a carcinomatous mass in the pelvis which seemed inoperable and the patient was not expected to live many months, but after a palliative colostomy went on for three and a half years. They vary very much in malignancy and in the rate of growth and unfortunately 50 per cent of them first come to the surgeon when the mass and gut are fixed to the surrounding tissue and in a stage that should be considered inoperable by radical methods.

DR HOWARD LILIENFEL said that first of all before operating on any case of carcinoma of the rectum he has invariably had the chest X-rayed

## CARCINOMA OF THE RECTUM AND RECTO-SIGMOID

Although the lungs are not the commonest seat of metastasis it does occur there and in two cases he was saved from doing an operation when metastasis was already established in the lungs. His other invariable procedure was to send to a man experienced in the use of radium all cases of inoperable carcinoma of the rectum. The first case in which he did this was a woman who was made worse and the disease did not seem to be affected by treatment with radium. The next patient was a man who had syphilis and diabetes and an enormous mass with a huge crater against the prostate. It did not appear as if he could stand operation and Doctor Quick was asked to treat him with radium. A specimen was removed by Doctor Quick and examined by Doctor Ewing and pronounced malignant. That man is now apparently well and there is no sign of any growth. He suffered extremely under the treatment and had to be given large doses of morphine. He still has paræsthesia, but he weighs more than ever before. This was unquestionably carcinoma of the rectum. In the next case the same picture was present, but the man developed a perforation between the rectum and bladder and had foul-smelling urine. After the application of radium that opening closed. He was watched for over a year, and while the tumor did not disappear its development became slower. The recto-vesicle fistula however closed up.

DR. GEORGE WOOLSEY said that one of the secrets of success in these cases of carcinoma of the rectum, as in all carcinomas is early operation. He thought that was one reason why the case he was to have presented at the last meeting had such a long post-operative life, i. e. twenty-three years and over. Another patient on whom he operated two and a half years ago was a comparatively early case, four weeks after symptoms developed. Yet at the time these cases were first examined the cancer was quite extensive. The glands of neither of these two cases were involved. The speaker expressed himself in favor of colostomy even in the low operation. It enables one to explore the abdomen if an opening somewhat larger than necessary for the colostomy is made. In the last case he was compelled to make the colostomy secondarily on account of some sloughing at the lower end of the gut. In the lower part of the gut the circulation is not always very good and there is danger of sloughing. The choice of operation should depend on the site, extent and duration of the tumor. He remembered two cases in the ward at Bellevue at the same time, both under thirty, which were very rapid in onset and recurrence. There are a number of these cases under thirty years of age.

DOCTOR RUSSILL in closing the discussion said that Pfeiffer in reviewing cases of carcinoma in children speaks of the rapidity with which the tumor grows, death occurring within six months of onset. The choice of operation depends on the patient but the abdominal-perineal operation was the one of choice with the speaker. As to the question of discovering carcinoma as an early small growth he had had two cases in which the earliest symptom was bleeding and both had been operated on for hemorrhoids. The diagnosis was made by sectioning through a sigmoidoscope. In reply to a question as to the operative mortality he had 16 deaths in 45 radical operations within three



months, about 35 per cent Twelve others were believed to have died within a year

---

*Stated Meeting Held March 25, 1925*

The President, DR EUGENE H POOL, in the Chair

PELVO-ABDOMINAL TUMOR DISSIPATED BY X-RAY THERAPY

DR FRANK S MATHIWS presented a man who had first applied for treatment December 27, 1924 He had left congenital cryptorchid For the past six months, he had noted a swelling in the lower abdomen which filled the entire pelvis and spread out on either side into the false pelvis and reached to the level of the umbilicus By rectal examination, a tense tumor flattened out the rectal wall and was firmly fixed The veins in the lower abdomen were engorged, as were also the superficial veins of both legs, and oedema of the legs extended up to the knees An abrasion over the right shin had failed to heal, was surrounded by an area of discoloration and seemed about to form an indolent ulcer The provisional diagnosis was an inoperable abdominal sarcoma, probably originating in the cryptorchid The patient was referred for radio-therapy to Dr F C Wood, who has given him eight treatments, the first being January 5 The following ones were the 9th and 20th, after which the tumor had disappeared These treatments were heavy, about 90 per cent of an erythema dose, at 200 K V, with 5 mm copper and 1 mm aluminum filters The subsequent treatments have been lighter prophylactic doses To-day the engorgement and oedema of the limbs has disappeared, the abrasion has healed and no tumor can be made out

DR WILLIAM B COLEY said that he had examined Doctor Mathews' patient very carefully and had been unable to find any trace of anything abnormal in the abdomen The case in his judgment shows that a very large inoperable abdominal metastasis, following sarcoma or teratoma of the testis, may disappear under either X-ray or radium treatment Doctor Coley recalled a case in his own experience at the Memorial Hospital some eight years ago, in which a tumor, considerably larger than the one found in Doctor Mathews' case, had disappeared under a single treatment of radium (12,000 mc hr at 10 cm distance), the tumor had nearly disappeared at the end of three weeks, at the end of a month, it had entirely disappeared and the patient gained considerably in weight At the end of four months, however, the disease recurred, causing death in six months The recurrent tumor showed little effect from further radiation In Doctor Mathews' case, Doctor Coley believed that the tumor would probably recur and prove fatal in the end In his opinion, the number of permanent cures in sarcoma of the testis would be greatly increased if prolonged treatment with the mixed toxins of erysipelas and *Bacillus prodigiosus* were used as a routine measure immediately after primary removal of the tumor Doctor Coley referred to one of his previous publications on *Cancer of the Testis*, containing a report of 64 cases personally observed, with special reference to 12 cases of cancer of the undescended testis In only one of the latter group of cases had a permanent cure been obtained, this was a case which had been operated upon by Dr Howard Lilienthal, in December, 1908, immediately after prolonged toxin treatment was begun and carried out under Doctor Coley's direction,

## RECONSTRUCTION OF FOREARM AND HAND

the patient is well at the present time. over sixteen years later Another case which he recalled had been referred to him in July 1908 by Dr John B. Murphy, after he had removed a very large round-cell sarcoma of the undescended testis. The toxins were given for nearly a year, the patient remained well for three years and then died of probable metastasis of the lung. Doctor Coley then described a case which he believed showed that much could sometimes be accomplished in far advanced inoperable cases treated by a combination of the local effect of radium with the systemic effect of the mixed toxins. The patient, a man of forty-two years had been referred to Doctor Coley by Dr Charles H. Mayo, in July 1919 with a large inoperable abdominal recurrence, together with metastasis in the supraclavicular region left side, the size of a hen's egg. Under a combination of toxin- and radium-treatment the mass apparently entirely disappeared. The toxins were kept up with occasional intervals of rest for several years and he received a radium-pack treatment annually. He remained in good health until a couple of months ago when he began to have symptoms of pain and discomfort in the region of the duodenum, although no palpable tumor could be discovered. exploratory operation done a week ago revealed a mass of enlarged glands in the upper abdomen just behind the duodenum.

DR CHARLES GORDON HEYD referred to a case in which he had operated for a sarcoma of the testicle. After orchidectomy an exploratory laparotomy was done which revealed a mass of glands along the aorta leading up to a larger mass surrounding the left kidney. Histological examination of the kidney tumor was the same as the testes. This patient was treated with radium and at the end of a year had no clinical or X-ray evidence of sarcoma. This patient was operated upon in 1919 and he has remained well ever since.

### RECONSTRUCTION WORK AFTER EXTENSIVE LACERATION OF FOREARM AND HAND

DR KIRBY DWIGHT presented a man twenty-eight years of age, who in August 1922 was struck by a Fifth Avenue bus and was dragged some distance. He was brought to Roosevelt Hospital and was operated upon at once. The following injuries to the right forearm and hand were found:

The skin together with the subcutaneous tissue and deep fascia had been torn almost entirely from the forearm from just above the elbow to the wrist. Only a narrow strip about 6 centimetres in width had been left extending from the medial side of the elbow to the anterior aspect of the wrist, and this had been separated from the deeper structures so that it formed a bridge. All the superficial muscles of the forearm were exposed and the extensors carpi radialis longior and brevior and the extensor communis digitorum were badly crushed and lacerated. There was a compound fracture of the middle third of the shaft of the radius with the upper end of the lower fragment projecting backward through the muscles and there was a posterior dislocation of the head of the ulna. The skin and palmar fascia had been torn from the entire palm, exposing the flexor tendons of the fingers. The thumb had been denuded of skin except over its distal phalanx and the small muscles of the thumb had been destroyed almost entirely. All the fingers were lacerated. Circulation and nerve trunks were not injured.

The operation consisted in a careful débridement, as it was realized that

the hope of saving the arm depended on the prevention of infection and the saving of the bridge of skin extending from the elbow to the wrist

Nothing was done at this time to the bones, as the condition of the patient did not warrant any further operative procedure

Dakinization was started at once. The manipulation of the arm was exceedingly painful, especially during dressings, so at the end of five days the arm was suspended by means of tongs in the radius. Suspension by the fingers was impossible owing to their laceration. This procedure added greatly to the comfort of the patient.

By the nineteenth day the granulations over the upper part of the forearm were ready for grafting, so this was done, using small deep grafts. At the same time the radius was wired after cutting away the tip of the lower fragment, which was exposed and had become necrotic.

During the fifth week Thiersch grafts were placed on the hand and the grafting of the forearm was completed.

In the ninth week the silver wire was removed from the radius, six weeks after it had been inserted. Union was firm, there were no sequestra.

Six months after injury there was no pronation or supination and the wrist was held in abduction due to the relative lengthening of the ulna. X-ray showed a bony bridge between the ulna and what had been the upper fragment of the radius. This was noticed now for the first time but the original callus must have been laid down while the fracture was still unreduced.

An incision was made over this bridge posteriorly and it was chiselled away. Then the head and about 3 cm of the shaft of the ulna were removed subperiosteally.

Pronation and supination immediately became free but the wrist remained fixed in abduction. There was a synostosis between the radius and the semilunar, caused, no doubt, by an inflammatory process set up by the tongs, and extending down to the wrist-joint.

One month later the semilunar bone was excised, using a posterior longitudinal incision medial to the extensor tendons of the fingers. As soon as this was done motion in the wrist became free.

About a year after his injury the patient entered the hospital for the fourth time in order to have a plastic operation done on the palm of his hand. At this time the palm was much contracted, drawing the fingers together. Motion of the fingers was limited and occurred principally at the metacarpophalangeal joints. The flexor muscles in the forearm had been developed considerably by a system of exercises he had been taking.

The scar tissue of the palm of the hand was dissected out. The tendons of the ring and little fingers were adherent to the scar but those of the index and middle fingers were perfectly free. A pedicle flap was made from the skin of the abdomen and sutured in place on the palm. The pedicle was cut after twenty-one days. It was at first intended to have the pedicle sufficiently large to bring around and cover the thumb but it had contracted and especially narrowed so much in the twenty-one days that this was not feasible.

About five months after this the patient entered the hospital for the fifth time. The hand was much improved, the palm was not so much contracted and the fingers were not drawn so much together. There was good active flexion at the metacarpophalangeal joints, but in so doing the fingers themselves remained straight. However, if some one held the proximal phalanges extended the patient could actively flex the interphalangeal joints.

The logical explanation for this phenomenon seemed to be that there was a lack of balance between the flexors and the extensors of the fingers. The

## SIMULTANEOUS CARCINOMA OF BOTH BREASTS

flexors and perhaps especially the lumbricales had become powerful through exercises in flexion, while the extensors had not been so exercised. In addition the latter had been the ones injured in the accident and had suffered actual loss of substance. And they might be hampered by the scar tissue at the site of the compound fracture. The motion that the patient could not do was to hold the proximal phalanges of the fingers extended by means of the extensors, while he flexed the middle and distal phalanges.

The scar tissue at the site of the fracture was removed and although no actual adhesion to the muscle could be found yet the function of the fingers seemed to improve a little soon after.

Since then the patient has been trying to use the hand in a normal natural way and has been exercising the extensor muscles instead of the flexor group. Considerable improvement has taken place, on active flexion of the fingers the interphalangeal as well as the metacarpo-phalangeal joints are bent.

## SIMULTANEOUS CARCINOMA OF BOTH BREASTS

DR JAMES M. HITZROJ presented a woman, age forty-seven, who was referred to him by Doctor Borland, of Lynbrook, on May 22, 1922, with a history of a lump in the left breast which she had noticed two weeks before that date and which attracted attention because of a drawing sensation in that breast. Twenty years ago, following the birth of a child, the patient had small lumps in both breasts. She has had a small lump in the right breast which she thinks she has had for a long time, but has noticed no recent change in it.

Examination of the breasts shows a small hard irregular nodule in the left breast in the upper outer quadrant slightly adherent to the skin, but otherwise movable. There were palpable nodes in the left axilla which were not large nor particularly hard. There was a similar nodule in the right breast but no palpable nodes in the right axilla.

May 23, 1923, the left breast was removed through an elliptical incision. Examination of a frozen section showed the tumor to be an adenocarcinoma. Further radical excision of the axillary contents and pectoral muscles was then done. The right breast was then removed by radical excision with skin graft to cover the area not closed by suture of the skin.

The pathological report of specimens of both breasts with pectoral muscles and axillary contents is as follows. The left breast is the seat of two hard, poorly circumscribed nodules having the gross features of carcinoma. The axillary contents contain slightly enlarged and opaque nodes. The right breast is the seat of a single hard, honey-combed nodule (about 1 to 1½ cm.), also having the gross features of carcinoma. Some of the axillary nodes are slightly enlarged and opaque.

Under the microscope the sections of all the tumors of both breasts have the features of adenocarcinoma. The lymph-nodes in both axillae show involvement.

The patient left the hospital sixteen days after the operation and has had no post-operative X-ray treatment. The patient has gained weight since the operation and now approximately three years after the operation, is entirely well and free from any signs of recurrence.

DR WILLIAM B. COLLY said he had observed a number of cases of bilateral breast tumor. He could recall some six or seven at the present moment. He had had however, only one case of simultaneous development of breast cancer and this had occurred in a young girl twenty-one years of

age, and had, apparently, been produced by a severe local trauma. This patient had fallen upon an icy pavement, severely bruising both breasts, two or three weeks later, tumors developed simultaneously in both breasts and grew very rapidly, the glands in both axillæ were involved. Although he did a complete radical operation, consisting of the removal of both breasts and the glands in the axillæ, a recurrence took place in about six months, causing death in less than a year. He also recalled a case of carcinoma of both breasts which had been apparently permanently cured. This patient, in 1906 and 1907, had had two operations performed on the left breast, microscopical diagnosis fibroadenoma, in the same year, the entire left breast was removed. One year later a recurrence developed in the right breast, removal was done in February, 1908. Microscopical diagnosis typical carcinoma. In February, 1909, there was a hard, carcinomatous mass occupying the entire left pectoral region with involvement of the cervical glands from the clavicle nearly to the mastoid. An absolutely hopeless prognosis was given to the patient's family, however, at their urgent request, Doctor Coley finally consented to try the toxins in the hope of possibly retarding the progress of the disease. The treatment was carried out at home by Dr. William J. Bott, of Palmyra, New York. Immediate and striking improvement took place with the first few weeks, the treatment was kept up for nearly two years, the patient remained well fourteen years, but this patient's family physician now informs him that, a few weeks ago an apparent recurrence was noticed in the axilla, which he intended to remove. The case will be more fully reported later.

## PULSATING EXOPHTHALMOS

DR. JAMES M. HERTZOG presented a woman, age thirty-seven, who was admitted to the New York Hospital, August 20, 1917, complaining of a roaring noise in her head and loss of sight in the left eye. The woman had been a patient at the New York Hospital for a varying number of conditions since 1906. In 1911, she had an operation for suppurating inguinal adenitis (bubo) and bilateral purulent salpingitis. In 1915, she began to have headaches, dizzy spells and pains over the left side of the head and vomiting attacks following a blow which she thinks she received over the left side of the head. At this time she had disturbance of vision in the right eye, some loss of external rotation in that eye and a four plus Wassermann. The X-ray showed roughening and irregularity of the sella turcica which was possibly due to an osteoperiostitis of the bone. During this period examination showed the field of vision limited in both eyes, more so on the right. There was œdema of the right optic nerve, the vessels were engorged and the pupil dilated and immovable. She was placed on antiluetic treatment, which was rather irregularly carried out because of the patient's irregular attendance.

In June, 1917, she was readmitted to the hospital complaining of a roaring noise in her head and difficulty in vision. There was a loud bruit over the entire head, most marked upon the left side, but well heard over both eyeballs. In the inner angle of the left eye there was a pulsating vessel with a distinct thrill, which thrill disappeared after compression of the left carotid artery. The field of vision was markedly limited in both eyes, most marked on the right eye in which there was practically no sight whatever, with atrophy of the optic as described. The left optic nerve was swollen and the vessels engorged.

## ACUTE PERFORATED PYLORIC ULCER

There was marked exophthalmos in both eyes. Operation was advised and refused.

In August, 1917 the patient returned to the hospital practically blind and consented to operation, which was done by the method of Porta. Through a transverse incision at the base of the neck the common carotid artery was occluded, by a strip of chromicized pig's bladder (Baer's membrane), about 0.5 cm. wide, which was tied about the common carotid artery until it almost occluded that vessel and only a very faint pulsation could be felt distal to the ligature. The intention was to completely occlude the vessel if no cerebral symptoms arose. Following the occlusion the roaring disappeared, the bruit disappeared, and the patient's sight in the left eye began to improve. The exophthalmos gradually diminished and the patient left the hospital sixteen days after the operation markedly improved. Since that time she has been under treatment in the Syphilology Clinic and has remained free from the symptoms for which the operation was done. Her left eye now has about three-quarters normal vision. There is none in the right eye.

### LATE RESULT OF SPLENECTOMY FOR IDIOPATHIC PURPURA

DR. JAMES M. HITZROJ presented a case of splenectomy for hemorrhagic purpura—which was reported in the *ANNALS OF SURGERY* for August, 1923, in the person of a girl, eight years old, who was admitted to the First Medical Division, New York Hospital, January 27, 1923, the removal of the spleen being done February 27, 1923. The patient has remained entirely well since the operation and now has practically a normal blood count with normal bleeding time.

### ACUTE PERFORATED PYLORIC ULCER, CONDITION TWENTY-ONE YEARS AFTER OPERATION

DR. ELISWORTH ELIOT, JR., presented a man, now fifty-nine years of age, on whom he operated for pyloric ulcer at the Presbyterian Hospital, twenty-one years ago. At that time he gave a gastric history extending over seven years, consisting of attacks of indigestion, nausea, and fainting attacks which sometimes interfered with his work for a number of days and at others did not even confine him to the house. There were no bloody or dark-colored stools and the attacks suggested appendicitis rather than gastric ulcer. On the twelfth of December, immediately after lunch, he was seized with intense pain and was taken to the hospital where, at 5 o'clock, his abdomen was opened and a perforated ulcer found on the anterior surface of the duodenum near the pylorus. The operation consisted of the closure of the perforation with a purse-string suture and the insertion of a cigarette drain. During convalescence the patient developed a bilateral phlebitis which eventually completely subsided. Since the operation he has enjoyed excellent health and has been entirely free from all gastric disturbance.

Recently an X-ray study has been made to determine the present condition of the duodenum at the site of the former perforation. This investigation was made by Doctor Imboden who reports that with the exception of a slight irregularity in its first part the duodenum as well as the stomach are in every respect entirely normal.

Doctor Eliot remarked that this case is not very exceptional, for of a considerable number of operations for closure of duodenal or pyloric perforations the majority of patients have remained well without the need of a subsequent gastro-enterostomy. Doctor Imboden is of the opinion, however, in which opinion the reporter agreed, that sufficient investigation with the

X-ray has not been done subsequent to the closure of a perforation, to determine the ultimate condition of the stomach and duodenum. In a very considerable number of cases, as in the present instance, the complete and permanent freedom from all subjective gastric disturbance for a long period would indicate that after the closure of a perforation without a gastro-enterostomy the ulcer had remained definitely healed and that a gastro-enterostomy at the time of closure would have been superfluous. The results of gastro-enterostomy in simple ulcer even though generally satisfactory, are so problematical because of the possible development of marginal ulcer and the need of subsequent surgical measures for recurrence or other complication that it is best to limit the primary operation to a simple closure of the perforation. In this connection some years ago after an exhaustive study to determine the frequency of subsequent gastric trouble after closure only of perforations, he could find no instance of mechanical pyloric obstruction within the first ten days after operation, and only one or two cases as early as the third week. Usually years elapsed before a gastro-enterostomy for either a recurrence or stenosis proved necessary, if at all. Furthermore he would like to emphasize the fact that in relatively inexperienced hands the addition of a gastro-enterostomy to the closure of the perforation materially increases the operative risk, and that most of these cases, belonging to the emergency class must necessarily be done by surgeons of limited experience.

#### CASE II GASTRO-ENTEROSTOMY FOR PYLORIC ULCER, SIX YEARS AFTER OPERATION

DOCTOR ELIOT presented also a woman who six years ago had a gastro-enterostomy performed for a typical duodenal ulcer near the pyloric ring. The patient made a good recovery. One year ago she returned with symptoms of enteroptosis. A roentgenogram showed a large excavated ulcer on the lesser curvature and a gastro-enterostomy orifice that was not working. If the ulcer had been situated near the pylorus a second gastro-enterostomy could have been made, but the ulcer was so large and on the lesser curvature that it was decided to postpone any operation. The patient was therefore given medical treatment with subsidence of all subjective symptoms. A few days ago another series of roentgenograms was taken and she was examined fluoroscopically by Doctor Imboden who found no indication of an ulcer on the lesser curvature and both the stomach and the gastro-enterostomy orifice were working satisfactorily. For some reason, perhaps a spasm, at the time the first roentgenogram was taken the gastro-enterostomy orifice did not work. This case illustrates well that in spite of a gastro-enterostomy recurrence sometimes appears even in aggravated form and that even under unfavorable conditions relief may be obtained without operation. It was the reporter's belief that all such cases should have the benefit of the same medical treatment as is ordinarily adopted for gastric and duodenal ulcers before any operation whatever is attempted.

DR LEON T LEWALD (by invitation) said that from the roentgenograms which Doctor Eliot showed, he believed that five out of ten roentgenologists would have made the diagnosis of duodenal ulcer at the present time, which shows how necessary it is to have the personal and clinical history of a case together with the X-ray findings before a roentgenologist can safely venture an opinion which should rarely, if ever, be based on the X-ray evidence alone. Here there is a persistent deformity of the duodenal cap due apparently to

adhesions which would lead to a diagnosis of a pathological condition being present. These cases should be followed up after a number of years. Doctor LeWald has followed a large number of cases for several months and in a few instances for several years after operation.

DR JOHN A. MCCRELRY was of the opinion that about one-half of the perforated ulcers would heal with a simple closure of the perforation. There was, however, a large percentage of cases whose symptoms would recur after this procedure, and he thought that many of these cases could be recognized at operation and, if the patient's condition permitted, a more extensive procedure such as a gastro-enterostomy or in suitable cases a Horsley operation could be performed so saving the patient a second operation.

In the experience of the First Surgical Division at Bellevue, covering over 40 cases in the past five years, there had been no mortality in the cases selected for immediate gastro-enterostomy.

In two cases in which it seemed advisable simply to close the perforation obstruction, made a secondary gastro-enterostomy necessary within ten days of the original procedure.

DR GEORGE WOOLSLY said that he had had to re-operate on patients who had been treated for perforation without gastro-enterostomy. One member of this Society had had a second perforation a few years after the first perforation, treated by suture, and he knew of others. Not a few of these cases have to be operated on again later, due to recurrence of ulcer or perforation to contractures. He believed that when the condition of the patient justified gastro-enterostomy that this was the proper thing to do. It is a safe thing to do and adds to the patient's prognosis both for the present and for the future. As to Doctor LeWald's statement that some roentgenologists would consider that the X-ray Doctor Eliot showed gave evidence of an active ulcer. He had operated that day on a patient at Bellevue Hospital on whom he had operated eight years ago for duodenal ulcer. She was well for two or three years and then symptoms recurred not those of ulcer, but epigastric fulness, much gas in stomach and pain and tenderness at site of gall-bladder, diagnosed as a gall-bladder condition. Stones were present in the gall-bladder which was removed. Then the duodenum was exposed, but did not present any evidence of ulcer, although the X-ray indicated its presence. He was loath to resect the duodenum, but finally decided to do so on account of a feeling of slight induration posteriorly. It was found that the old ulcer had healed. One could see that the crater had been covered over by continuous mucous membrane and there was no macroscopic evidence of an active ulcer that the X-ray report had indicated. This was later confirmed by microscopic examination.

DR WILLIAM B. COLRY stated that his oldest case of perforated ulcer treated by simple closure without gastro-enterostomy is now well fifteen years later. He believes that surgical opinion at the present time both here and in England favors simple closure, reserving gastro-enterostomy for a later operation in case there is a recurrence of symptoms. In his opinion



gastro-enterostomy performed as a routine measure at the time of perforation would add distinctly to the mortality, but if reserved for the comparatively small number of cases that later develop recurrence, it can be performed with much greater safety

DR JOHN F CONNORS said that in 1915, he published a report of 45 cases of perforated gastric and duodenal ulcer with 8 deaths. He was very glad to hear Doctor Eliot advocate simple closure in these cases. Personally he thought this the only thing to do. Four years ago he argued this subject with Doctor Deaver who advocated the additional gastro-enterostomy, but he is still convinced that in the ordinary run of cases simple closure is the ideal method. Doctor Eliot spoke of this case having had no return of symptoms after twenty-one years. Doctor Connors has a case which he operated upon fourteen years ago for two perforations in the anterior wall of the stomach which has remained free from symptoms. In the 39 cases which were closed by suture, in many of which he felt that he caused a pyloric obstruction, in only two of these cases was it necessary to re-operate on account of pyloric obstruction. In reference to the Horsley operation the last two cases upon which this operation was done on his service ended fatally.

DR CHARLES GORDON HEYD said that for the last four years at the Post-graduate Hospital they had been doing the Horsley operation for duodenal ulcer. He recalled two cases with acute perforation, previous to this time, in which the perforation was closed. The first patient made an uneventful recovery and gave no further evidence of ulcer. The second patient also had the perforation closed and six years later he had a profuse gastric hemorrhage. Rontgen-ray examination revealed no defect and he has been free from symptoms from that time to date. In the last four years in twenty cases in which the Horsley operation had been done, there had been no mortality. This operation accomplishes a complete cure of the ulcer and gives adequate drainage through the pylorus.

DR RICHARD LEWISOHN said that the question whether one should add gastro-enterostomy in cases of perforated pyloric or duodenal ulcers must be decided by the individual case. If there is marked stenosis after the suture of the perforation, it is wise to add gastro-enterostomy. Some years ago the speaker advised adding gastro-enterostomy in every case, because he then felt that this operation might be an important factor in the cure of the ulcer. His viewpoint has changed since then and he does not now believe gastro-enterostomy ought to be performed simply as an added factor for the purpose of curing the ulcer. Whether as often stated, the perforation of an ulcer practically assures a permanent cure, is very doubtful, the speaker has seen many cases that were proof to the contrary. He has seen cases requiring re-operation four years and even more after suture of a perforated ulcer. The secondary operation showed the ulcer in the same place, where it had been found at the time of the perforation.

Regarding Doctor Eliot's second case, it was probable that the ulcer had healed, but only temporarily, he had seen this happen quite often. There is

## GASTRO-ENTEROSTOMY FOR PYLORIC ULCER

a life cycle of an ulcer, they flare up and without treatment they practically disappear, and then flare up again. He did not think it had been proven that the case was improved through medical treatment. The question of how much medical treatment helps in ulcer cases, especially in gastric ulcer is still an open one.

DR JAMES M HITZROI said that he could not agree with Doctor Eliot that ulcer of the lesser curvature was a condition which should be treated medically. He had three cases recently which had been so treated and which finally came to operation with a carcinomatous change in the ulcer. A number of the cases on the First Division at the New York Hospital have been found to be carcinomatous at operation. Balfour makes the statement that ulcers on the lesser curvature are not medical cases because of their tendency to undergo carcinomatous change. Doctor Hitzroi felt that because of this tendency to carcinomatous degeneration operation was much more advisable in the early stages of the disease.

DR EUGENE H POOL said that some years ago (ANNALS OF SURGERY, 1922, vol LXVI, p 457) Doctor Dineen and he investigated a series of about 59 cases of perforated ulcer to find out what proportion of those in whom the perforation was sutured and no gastro-enterostomy done had recurrence of gastric symptoms and came to operation. They found that about one in three definitely recurred. There were 10 such cases out of a few over 30 followed for some years. Of the 10, 7 had a secondary gastro-enterostomy performed and the other three had pyloric obstruction but refused operation. In some the symptoms developed a considerable period after the first operation. So one may wrongly imagine for a number of years that a patient is cured. If a primary gastro-enterostomy is done as a routine measure, 2 out of 3 cases are subjected to this procedure unnecessarily. In the cases which later need a gastro-enterostomy, it may be done with relative safety and under definite indications. Of course, all the cases must be carefully followed. The point is that routine employment of gastro-enterostomy for perforated ulcers should be condemned. In certain selected cases it should be done. The indications are almost self-evident.

## SARCOMA OF TRACHEA, CONDITION TEN YEARS AFTER OPERATION

DR ELISWORTH ELIOT, JR presented a young man who eleven years ago gave a history of a small lump in the thyroid region of six months' duration, and loss of voice. Examination by the laryngoscope was unsatisfactory, although the vocal cords were narrower, there was some encroachment on the lumen of the upper part of the trachea. On operation a round mass under the thyroid isthmus, which was attached to the trachea and did not move with deglutition was removed and proved to be a small spindle-celled sarcoma. Hemostasis was satisfactory and convalescence prompt. Eight months afterward he was re-admitted to the hospital with a recurrence and was again operated on by one of his associates. The tumor had then become adherent to the trachea so that a bit of tracheal tissue was excised in its removal and damage was done to the left jugular vein which was quickly repaired. During the past eleven years the patient had cooperated with the follow-up system of

the Presbyterian Hospital. During the first two years after operation he was referred to the General Memorial Hospital for treatment with X-ray and to Doctor Coley for injections of toxins, the latter being continued for one year, about five years ago radium was applied for a period of six months as a precautionary measure. His hoarseness is less now than before the first operation. He is working regularly, has not lost weight or flesh, and X-ray of the chest shows no indication of metastasis.

## ANATOMY AND TREATMENT OF REDUCIBLE INGUINAL HERNIA

DR ELLSWORTH ELIOT, JR., read a paper with the above title, for which see page 441, September ANNALS OF SURGERY.

DR WILLIAM B. COLBY said that as to Doctor Eliot's statement that "It is only in cases of long standing, when the sac is of large size, that the cord may lie along its inner side along the site previously occupied in fetal life by the processus sacciformis an acquired inguinal hernia might naturally be expected to develop, Nature's obliteration of the processus sacciformis, however, is so complete that the resulting connective tissue strand can rarely be identified and the process of repair is so effective that, in an acquired inguinal hernia the parietal peritoneum, finding a path of lesser resistance than that along the obliterated pouch, protrudes through the internal ring along the inner side of the cord and close to the outer side of the deep epigastric vessels. In a large number of incipient inguinal herniæ the writer has found this relation constant." His own experience is not in accord with Doctor Eliot's, for he had found the sac to lie anterior to the structures of the cord not only in the so-called congenital type in which the tunica vaginalis communicates with the hernial sac, but in practically all other stages of development of an oblique inguinal hernia from the small incipient sac to the large scrotal hernia. His understanding of the development of a so-called acquired hernia, apparently, differs somewhat from Doctor Eliot's. He believed with Hamilton Russell that practically all cases of oblique inguinal hernia are really of congenital origin, that is that they develop in an unobliterated process of peritoneum which was present at birth and never became entirely obliterated. Whereas, Doctor Eliot states that Nature's obliteration is so complete that the resulting connective tissue strand can rarely be identified. In all cases of oblique inguinal hernia both in children and in adults, the speaker had found the sac spread out like a fan over the entire anterior surface of the cord and surrounded in common with the cord by a thin layer of fascia. It is only in the direct type of hernia in which the sac, never having been inside of this layer of fascia, protrudes forward and usually to inner side without intimate relation with the cord itself as hernia develops.

The relationship of the sac to the cord is well brought out by Hamilton Russell in his paper on *Inguinal Herniæ: Their Varieties, Mode of Origin, and Classification* (*British Journal of Surgery*, April, 1922, p. 502). Russell believes that all varieties of oblique inguinal hernia are determined by developmental variations in the anatomy of the processus vaginalis. He states that it would seem practically impossible that a new and acquired sac

## ANATOMY AND TREATMENT OF REDUCIBLE INGUINAL HERNIA

could find its way through the canal and into the scrotum spreading out in a fan-like manner, having the most close relations with the cord and the vessels and surrounded by a covered membrane

Doctor Eliot states that in cases of unilateral bubonocoele in adults in which the frequency with which a hernia subsequently develops within a comparatively short time on the non-affected side, has led him to advise simultaneous operation on both sides when the external abdominal ring of the non-affected side is lax and of increased dimensions. While this practice has been adopted by a number of well-known surgeons the speaker had never yet been convinced that it was a wise one. While it is true that operation on the non-affected side or the side on which there is a slightly enlarged ring, often shows the presence of a very slight funicular process or incipient sac well within the internal ring especially on traction of the cord, he believed that the great majority of these patients may go on for many years and perhaps for their entire life, without the development of an actual hernia. A study of end-results in cases at the Hospital for Ruptured and Crippled supports this view.

He was glad to know that Doctor Eliot regards the Bassini operation as one not only well deserving of recognition but one which, in spite of certain minor modifications in technic, is still based on sound surgical principles. It is rather remarkable that an operation which the general consensus of surgical opinion for more than thirty years had regarded as highly satisfactory should suddenly be discovered to be based on erroneous anatomical and surgical principles.

Although Seelig and Chouke, after an elaborate series of experiments on animals reached the conclusion that firm union is impossible when muscle is united to fascia and that, therefore, it is quite useless to suture the internal oblique to Poupart's ligament, Doctor Eliot's experience, confirmed by that of Dowd and Lyle, show that in human beings, firm and lasting union does occur when the internal oblique is sutured to Poupart's ligament. The speaker was entirely in accord with this opinion. He had operated on many cases of recurrent hernia in which a small recurrence had taken place at some portion of the canal usually at the lower end and yet over the whole remaining portion of the canal the internal oblique was so firmly united with Poupart's ligament that it was almost impossible to dissect it off. He believed that the recurrences in these cases are due to failure in technic rather than to lack of efficiency in the principles of the Bassini operation. Whatever may be the fate of muscle united to fascia in animals we know that in human beings firm union certainly does occur between the internal oblique muscle and Poupart's ligament when united by proper and careful technic. Recurrences following the Bassini operation usually occur in the internal ring and this because too large an opening is made for transplanting the cord. Other recurrences take place in the lower angle of the wound above the pubic spine. The number of both types of recurrence may be materially lessened by observing the following points at operation: (1) placing a suture above the cord limiting the size of the internal ring to the size of the cord in the individual

case, (2) for the lowermost suture using the stitch described in the article on Hernia in *Keen's Surgery*, vol. iv. This suture is so placed as to include the reflected portion of the external oblique and conjoined tendon, both of which are brought into contact with Poupart's ligament just as it enters the pubic spine, thus uniting fascia to fascia instead of muscle to fascia. For suture material, he advocates the use of medium-size kangaroo tendon.

A modification which Doctor Eliot has made use of, *ie*, overlapping the external oblique fascia is of very great value in certain cases where the aponeurosis is particularly lax, and especially in direct hernia. In the great majority of cases of inguinal hernia, especially in young adults, the aponeurosis is not lax and could not be made to overlap the cord without undue pressure, in these cases the overlapping is entirely unnecessary. Furthermore, his own results show that the typical Bassini operation, supplemented by the use of the sutures he had described, is capable of producing a permanent cure in the great majority of cases.

Seelig's idea that muscle will not unite to fascia has been adopted by Gallie, Edmund Andrews, and others, and the opinion is freely expressed that the number of recurrences following the Bassini operation is at present very large. Furthermore, the statistics of the Hospital for Ruptured and Crippled are held in light regard on the ground that they cover mostly hernias in children which can easily be cured by any method of treatment. This view is held by some in spite of the fact that, prior to the adoption of the Bassini operation at the Hospital for Ruptured and Crippled the statistics showed 40 per cent recurrences in children in one year, since the adoption of the Bassini method the percentage of recurrences in children has been less than one. Another criticism of the statistics of the Hospital for Ruptured and Crippled is, that the cases have not been followed up, and that if they had the number of recurrences in adults would be found to be very large. He had just recently taken occasion to examine a series of 100 cases operated upon by himself by the Bassini method, with the use of kangaroo suture, in the years 1895 to 1897 inclusive, the types of hernia included are large irreducible, sliding cæcal, femoral, ventral, and oblique inguinal, ninety cases were traced from one to fourteen years, there were only two relapses, one, a slight weakness which developed almost two years later, and the other, a small recurrence which developed two and one-half years later following a kick received while fighting. Our recent statistics show a larger percentage of recurrences in adults, but this I believe may be accounted for by the fact that a very much larger number of patients are now being operated upon and it is extremely difficult to get a follow-up note on many of these cases, furthermore, a much larger number of operations are now being performed by the house-staff.

The real problem of the radical cure of hernia that has not been solved—or at least not until recently—is connected with direct hernia. It is probable that 10 to 15 per cent of recurrences follow operations for direct hernia, even in the hands of skilful operators. Great improvements have been made in the technic of operation for direct hernia by Bloodgood, Downes, Andrews,

Schley and others, but the greatest advance in the treatment of this type of hernia must be credited to Gallie, of Toronto. While the method of using fascial strips for sutures was originated by McArthur twenty-four years ago, these strips were left attached at their proximal end and they were limited in supply to the fascia of the external oblique. Gallie conceived the idea of fascial strips retaining their vitality indefinitely without attachment, and he confirmed the truth of this opinion by many experiments on animals. He then cut strips of fascia from the fascia lata of the thigh and used these sutures to close the large openings of direct hernia and recurrent hernia, and showed 60 cases thus treated, without recurrence. The speaker began using this method a little over a year ago and had now operated upon 60 cases of large direct and large recurrent hernia, with so far only two relapses, practically all of these cases have been traced. It is important to note that neither Gallie nor McArthur advise the use of fascial strips as a routine measure, but reserve this method for cases of large direct, and recurrent hernia.

DR F. T. VAN BULLEN, JR., said that he agreed with Doctor Eliot that the sac was on the inner side of the cord. One can demonstrate this easily by displacing cord outward and find sac beneath it and to inner side of it.

DR H. H. M. LYLE said that in the discussion of the suture materials where applicable, he used the McArthur attached fascial strips. He has employed this method in more than one hundred cases. He had at first used the Gallie method of detached strips from the fascia lata, but now reserves the Gallie method for those cases in which sufficient fascia cannot be obtained from the external oblique.

The use of fascia as a suture material in hernia is based on sound physiological principles. It is a strong, supple, living suture which becomes intimately incorporated in the structures. Doctor Lyle emphasized that no matter what the suture material was, all tension must be avoided. Tight suturing means tissue tension, impairment of nutrition and the possibility of a replacement fibrosis. Such tension can be easily avoided by the elementary procedure of placing parts in a position of muscular rest. The flexed and relaxed position simplifies closure, aids union and insures a comfortable convalescence.

DOCTOR LYLE has employed the position of physiological muscular balance for fifteen years and found it most satisfactory. For details he referred to his paper on "Value of Position in Operative Treatment of Inguinal Hernia." SGO November, 1920 pp 529-530.

DR Seward Erdman remarked as to Doctor Eliot's statement as to the relation of the sac to the structures of the spermatic cord in the ordinary oblique inguinal hernia. His idea had always been that the oblique sac lies superficial to the cord in the inguinal canal. When the sac and cord are dissected well up to the internal ring the structures are found to be arranged in the form of a rough triangle, the vessels to the outer side, the vas to the inner side and the neck of the hernial sac above and between thus the hernial sac appears to have "skidded" out between and a little above the spermatic vessels which lie lateral and the vas which lies medial.

As for Doctor Eliot's statement regarding the frequency with which a potential hernia exists on the side opposite to that on which the definite hernia is present, Doctor Erdman said that in his own statistical study of inguinal hernia, published some years ago, direct hernia sooner or later was demonstrated to be bilateral in 66 per cent of all cases, whereas in oblique hernia 25 per cent eventually developed bilateral herniæ.

DOCTOR ELIOT, in closing the discussion, said that his paper dealt with oblique inguinal hernia in the adult rather than in children, and the relation he had tried to emphasize of the neck of the sac to the cord pertained to adults. He could quote at least one instance in support of the theory that the sac in oblique inguinal hernia does not follow the original course of congenital hernia. That was observed in a young adult of sixteen in which a peritoneal pouch without any communication with the peritoneal cavity was found in the inguinal canal. On further investigation the actual hernial sac was found lying to the inner side of this pouch, while its neck was interposed between the cord and deep epigastric vessels as demonstrated in the paper. The writer had stated that eventually a rotation of the neck of the sac around the cord occurred with the result that ultimately the sac lies anterior and to the outer side of the cord in the position Doctor Coley describes. The only way to settle the question is for both to search for the sac, for Doctor Coley to watch Doctor Eliot during an operation and *vice versa*, when a satisfactory conclusion might be reached. Doctor Coley believes that the sac lies at the outer side of the cord, the speaker believes that the cord lies between the deep epigastric vessels and the vas deferens.

If Doctor Coley remains unconvinced, the writer is certain that by actual demonstration on the living subject the position of the sac could be substantiated as herein described.

#### To Contributors and Subscribers

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

#### ANNALS of SURGERY

227-231 So. 6th Street

Philadelphia, Penna.

# ANNALS *of* SURGERY

VOL. LXXXII

NOVEMBER, 1925

No. 5

## EPITHELIAL HYPERPLASIA OF THE BREAST

BY SIR GEORGE LENTHAL CHEATLE, F.R.C.S

OF LONDON, ENG

THE glandular elements of the breast are developed from the surface epithelium. The site of the future breast is marked by a mere dimple from which branches of epithelium penetrate the underlying mesoblast. It is accurate to regard the breast as a gland derived from the skin, hence it is very interesting to compare the reactions of the skin and the epithelium of the breast to local irritation. Let me take first the reaction of the human skin to the application of tar. The reaction is marked by a sequence of events which respectively appear after definite lapses of time so that young tar workers suffer from different lesions to those that affect the middle-aged and the lesion that affects still older workers is different from those that affect the young and middle aged.

Among the first things to be noticed is a desquamative epithelial hyperplasia combined with which there is frequently a hyperplasia of the underlying connective tissue which consists of newly formed fibrous tissue and possibly a collection of small round cells with large nuclei exactly resembling lymphocytes. Young tar workers suffer from this lesion.

As time advances, the second event that attracts attention is the formation of papillomata or warts, the epithelium covering which is not desquamative in type. For want of a better nomenclature I apply the term "dysgenetic" to distinguish it from the purely desquamative type. By "dysgenetic epithelial hyperplasia," I mean pathological epithelial growth.

Third in the sequence of events is a dysgenetic epithelial hyperplasia that morphologically looks like squamous epithelium, although it is completely limited within normal boundaries. Spontaneous cure often happens by a sloughing out of the lesion. The period of life at which this lesion occurs is early middle age.

The fourth and last event in the sequence is the appearance of a typical squamous epithelium the cells of which invade and undergo metastasis. The lesion affects the workers of about forty-five years of age and onwards. The application of X-rays to the human skin induces the same pathological changes and in the same sequence and corresponding times.

Before leaving this part of my subject, I must say that precisely the same



morphological changes occurring in the same sequence in corresponding times also occur in the skin of mice after the application of tar. The whole sequence takes up about a quarter of a mouse's lifetime. The importance of calling attention to these experiments in mice is that it enables one to allude to an observation made by Dr A J Murray, F R S. From the growth in a mouse, suffering from the third event of my sequence, Doctor Murray transplanted epithelial cells into the underlying tissues of the same animal where they grew and from where they metastasized. They behaved like malignant cells after they were removed from a growth that was strictly limited to normal boundaries. Were these transplanted cells malignant when *in situ* or did they become malignant only when they were transplanted? Doctor Murray's experiment is interesting because its significance can be applied to the third event of my sequence which I described in human tar workers. Before concluding my observations on the effects of tar on the human skin, I wish to call attention to the fact that in any one of the first three changes, intercurrent impulses may arise that may arrest or prolong them or hasten them into the fourth and final catastrophe of carcinoma.

Now let me compare the pathological changes in the epithelium of the breast with those I have described in the skin. It will be seen that they are identical in type and sequence. The first event in the sequence of pathological epithelial changes in the breast is a desquamative epithelial hyperplasia that occurs mainly in terminal ducts alone or acini alone or in terminal ducts and the acini communicating with them. I wish the reader to note particularly the site of this change, *viz* the terminal ducts and acini because it is here that a common type of carcinoma begins.

There are two types of desquamative hyperplasia. The first is a very diffused and generalized form which results in a collection of degenerated, desiccated, small atrophied epithelial cells. The state is capable of inducing great pain. Besides occurring diffusely throughout a breast, it is also seen in fibroadenomata. The second type is a much more important type because the subsequent events of the sequence are seen occurring in its presence, as if it were a factor in inducing their presence. The important facts to note about it are that it exists alone, it is less generalized than the first type of desquamative epithelial hyperplasia, I have just described. It has special histological features and it is as a rule painless. Like the first type, it begins in the terminal ducts and acini, either of which may contain, separately, the lesion. The cells of ducts and acini become elongated and feathery. The whole or only part of the lumen may be affected, only in the ducts the process ends in a collection of colostrum-like cells which can be seen in all stages of formation arising from the feathery cells of the ducts. There is also a hyperplasia of the peri-canalicular and interacinous connective tissue where newly formed fibrous tissue is seen and among which there is an occasional collection of lymphocytes. Unlike the skin the ducts and acini possess

## EPITHELIAL HYPERPLASIA OF THE BREAST

apposing walls which are distended by the accumulation of cells resulting from the process of desquamation. Hence the process is one of the causes of cysts in the breast. Desquamative epithelial hyperplasia affects the breasts of women of about thirty years of age.

The second event of sequence is the formation of papillomata, which may grow in an ampulla only, but usually they are much more general in distribution when they affect the whole duct or more than one duct, a fact that is beautifully demonstrated when whole, microscopic sections of a breast are cut in series.

The third form of epithelial hyperplasia and next in sequence is a dysgenetic hyperplasia that morphologically looks malignant and yet shows no sign whatever of having transgressed natural boundaries. Like desquamative epithelial hyperplasia, it affects mainly acini and terminal ducts. This third stage corresponds to the third stage of pathological changes I have described in human skin after the application of tar. I regard it as malignant and would refer the reader to the significant experiment performed by Dr. A. J. Murray, which seems to me to be as applicable to this state of the breast as to tar carcinoma. The age of the patient is usually about forty years.

The fourth and last event in the sequence is carcinoma. Epithelial cells have invaded outside structures and metastasized. The invading cells have been derived from a dysgenetic epithelial hyperplasia occurring in the terminal ducts and acini. The site of this dysgenetic growth is the same as the pathological changes in the first and third events of the sequence. The age of the patient suffering from this event is usually forty-five years. In the lesions of the first three events in the sequence of breast changes there is microscopic evidence to show that the epithelial cells may degenerate and die and that the process may be arrested. Hence the pathological changes in the epithelial elements of the breast are identical in sequence and respective characters to those that occur in the skin after the application of tar.

To make myself clear in the final remarks of my paper, it is essential to repeat, in the order of their sequence, the pathological changes I have described in the skin and in the breast. They are as follows:

1. Desquamative epithelial hyperplasia
2. Papillomata
3. Hyperplasia of epithelial cells that morphologically look malignant and yet are strictly confined within normal boundaries
4. Carcinoma

The epithelial hyperplasia in 2, 3, and 4 are dysgenetic and not desquamative in type.

A. It may be wondered by what right do I attribute the pathological changes I have described in the breast to direct local irritation. A great deal of my work has been devoted to the study of epithelial changes in the ducts and acini. I have made it a necessary feature that the microscopical

examination should be made from complete microscopical sections of the whole breast. To enable one to do this, I have had made a large microtome, so that I can examine sections of whole breast that have been cut in paraffin and in series. Sometimes a whole duct as it enters and empties itself on the surface of the nipple can be examined, it is patent from beginning to end, and there appears nothing to prevent the entrance of agents of irritation. Also, a study of these whole sections demonstrates the fact that only one duct and its branches may be affected throughout its whole length by papillomata. The affection of only one duct compels one to assume a local irritant applied to that particular duct and not to any other ducts. The third and fourth states in my list may also exist only in one duct and its branches in respective breasts. Lastly, there is the evidence of the same types of lesions in the skin which are known to be induced by the direct effect of local irritation.

B Under the titles of desquamative and dysgenetic epithelial hyperplasia, I have described pathological lesions that are regarded as being those of "chronic mastitis." I think the term is erroneous and misleading. I consider too many and important lesions are grouped under this term. More important still is the fact that they are all forms of hyperplasia. Incomplete as knowledge is upon all forms of growth, yet more is known concerning them than when the term "chronic mastitis" first crept into the nomenclature of disease. It is time that all forms of growth were now spoken of in terms of "hyperplasia" and not in terms of "inflammation." The use of the term "hyperplasia" at once creates a true conception of the changes that are being induced and leads to correct trains of thought that concern the possible and probable futures of the lesions that are under particular review.

C The fact that desquamative epithelial hyperplasia is among the first lesions to be produced by direct local irritation makes its relation to carcinoma possible and indeed probable. There is another fact that increases the probability. It occurs in the same parts of the breast as carcinoma, *viz* in the terminal ducts and acini. I regard desquamative epithelial hyperplasia, particularly the second type of it, as a definite preliminary state to carcinoma, but one in which carcinoma is not an inevitable result. Many factors and impulses may arise that arrest or prolong the progress of the condition or even hasten it into carcinoma. In discussing precancerous states, I believe the most important one and that which is nearest to the final catastrophe of carcinoma is the third event in my list. That from which Dr A. J. Murray when experimenting on a mouse transplanted some epithelial cells from the position in which they were growing into the underlying tissues of the same animal. In their new situation these cells grew and metastasis occurred. The questions of importance here are, were these cells malignant in the position where they were growing, or did they become malignant only when they had been transplanted? In considering this point it must be borne in mind that when the papillomata (the second event in sequence) are thus

transplanted, the transplanted epithelial cells either atrophy or develop an implantation cyst, they do not metastasize. Hence the third state of my sequence of events is the nearest state to carcinoma without being carcinoma, and therefore it is the real precancerous state. Examples of the third event can be seen in all instances of carcinoma of the breast, where the epithelial invasion has not given rise to chaos that obliterates all normal structures. Even when carcinoma exists in a breast, it is extremely difficult to detect the actual focus or foci where the epithelial cells escaped from their normal boundaries. Although I consider the third event of the sequence the truly precancerous state, yet I consider that there is no state of epithelial hyperplasia that will inevitably terminate in carcinoma. So long as dysgenetic types of epithelial hyperplasia are strictly confined within normal boundaries, some intermittent impulse may arise that induces their atrophy and disappearance or prolongs their confined existence.

D The recent work of Doctor Gye and Mr. Barnard is of such vast importance that it will necessitate a fresh orientation of all notions that prevailed before their work was published. For this reason I have tried to confine my statements to those events that may be explained but not materially altered by their work.

# ACUTE HYPOTENSION OF CEREBRO-SPINAL FLUID FOLLOWING CRANIAL TRAUMATISM

By E. STULZ, M.D.

AND

P. STRICKER, M.D.

OF STRASBOURG, FRANCE

FROM THE CLINIQUE CHIRURGICALE A, FACULTÉ DE MÉDECINE DE STRASBOURG (DIRECTEUR PROF. R. LERICHE)

It is a matter of fact that the pressure of the cerebro-spinal fluid is lowered in some cases of cranial trauma. In these cases the evacuation of cerebro-spinal fluid by lumbar puncture leads to an exaggeration of the nervous accidents while on the contrary the raising of its pressure has at once a favorable influence and transforms the condition of the patient. Hypotension of the cerebro-spinal fluid therefore seems, to some extent at least, to play a prominent part in the symptomatology of cranial traumatism, and the actual existence of a well-individualized syndrome of acute hypotension of the cerebro-spinal fluid seems to be established beyond doubt.

M. Leriche has been the first to point out these hitherto unknown facts. He proposed at first the treatment of this hypotension by hypodermic injection of artificial serum, later on, suggested by the research work of Weed and MacKibben, he tried intravenous injection of distilled water by which he obtained a very quick modification of the hypotension of cerebro-spinal fluid. He further tried to verify in man the data given by the experimental work of the American physiologists. The application of the new therapeutical method to man in a case of severe fracture of the pars petrosa with discharge of cerebro-spinal fluid by the ear, demonstrated with experimental accuracy the influence of distilled water injection on lowered pressure. The intravenous injection of 30 c cm of distilled water raised in some minutes the volume and the strength of the discharge while at the same time the patient came out of the comatose state in which he was plunged. Every new injection produced the same phenomena.

In this clinical case the hypotension was caused by a loss of cerebro-spinal fluid that could be both seen and evaluated.

In cases of skull fracture without apparent discharge of cerebro-spinal fluid hypotension is also met with rather often. Theoretically, every time the subarachnoid spaces are opened, the equilibrium of the fluid is broken and the pressure may decrease more or less quickly. We have observed the syndrome of acute hypotension even in cases of less severe cranio-cerebral traumatism, in which the signs of important lesions of the cranium were wanting and we had merely diagnosed *commotio cerebri*.

The three cases whose record we think interesting to give are patients of

M. Leriche. They all showed hypotension of cerebro-spinal fluid without having presented unmistakable signs of skull fracture

CASE I—The first patient, L., eighteen years old, was hit by a big piece of wood on the head on January 13, 1925. He lost consciousness. Was brought to the ward at 9 A.M. He regained consciousness soon after but was in a very marked state of shock, being cold, pallid, with a pulse at 60, and answered questions in a tired and prostrated way. The reflexes were normal but exaggerated, the pupils were equal, round, their reflexes well marked. There were no signs of paralysis or contracture. There was hæmatoma of the left parietal region. The pulse was stronger after some hours, but the patient remained pallid and prostrated, lumbar puncture practised at noon showed a sanguinolent fluid that issued in a "jet"

The needle of Claude's apparatus rises to 75 (lateral decubitus), but falls quickly to about 0 and stays there. After intravenous injection of 35 ccm of distilled water, the patient feels better, opens the eyes and answers our questions more readily. The needle of the manometer has risen to 12.

In the evening pulsations are more frequent and stronger. The next morning the patient feels very well subjectively, his face is well colored, the pulse beats at ninety, the cephalæa has disappeared. In the evening, the subjective state becomes again less favorable, the cephalæa has reappeared. A new lumbar puncture produces only a few drops of sanguinolent fluid, the manometer indicating no pressure whatever. A second injection of 25 ccm of distilled water raises the pressure slowly to 8, 10, 11 and 12. After this injection the patient feels strikingly improved. His condition remains the same till January 23. On this day a lumbar puncture shows a pressure of 45/47. No incident is noted after this last puncture, the patient leaves on the 29th, perfectly well.

CASE II—The second patient, Leo O., twenty years old, falls downstairs, striking on his occipital region, on November 19, 1924. He was brought to the ward in a state of pronounced stupor, but he was still able to answer questions satisfactorily. He had no recollection whatever of his accident and did not remember how he got to the ward. He complains of excruciating occipital cephalalgia, has not vomited. Pulse beats at 84, temperature  $37.4^{\circ}$  C. The pupils are extremely dilated, of equal width, react to light. The tendinous reflexes are normal, there is no Babinski, no paralysis, no contracture. On the other hand, there are no local signs of fracture of the base. Lumbar puncture, practised on the patient's arrival, gives issue to a clear fluid, showing a pressure of 40 cm of water, the patient being sitting up at the time.

On the next morning the patient is still markedly stuporous, he keeps quiet with his eyes open and answers lazily the questions he is asked. The day afterwards he is about in the same state. His pulse is full but somewhat slow, he feels vertigo when made to sit up in bed. The pupils remain enlarged. On the third day, more than forty-eight hours after the traumatism, the patient begins to vomit, his torpidness increases and becomes nearly semi-coma. Pulse remains full but is markedly slower, beating at 64 instead of 70 and more the days before. His paleness is striking, the pupils react well, the reflexes are normal, the breathing is superficial, not accelerated. Lumbar puncture at 10 A.M., there issues a simple drop of transparent fluid. The manometer indicates no pressure. A second puncture is then practised one intervertebral space higher, without any fluid issuing.

We inject 30 ccm of distilled water into a vein of the patient's arm. The arterial pressure, measured with Pachon's oscillometer, stood before the injection at 15/9, index 2, and fell after the injection to 13/8, index 1.5. Immediately after the injection the patient awakes from his torpidness, sits up in bed, gives quick and precise answers and

knows easily his surroundings The pupils, widened before, are now contracted In the afternoon the pulse beats up to 72 In the evening (6 P M ) the patient is vomiting again, complains of cephalalgia, is again stupid, and remains stretched helplessly in bed, assuming an attitude "en chien de fusil" The pulse lowered down to 62 The patient gets a hypodermic injection of physiologic serum without perceivable result In the night vomiting reappears

On the fourth day the pulse stays at 60, the torpid state is unchanged, the patient is still lying "en chien de fusil" At first sight one thinks of a meningeal state, though there is no Kernig, no well-defined stiffness of the neck About 10 A M, 30 c cm of distilled water are again injected after a new lumbar puncture has given issue to no fluid whatever nor evidenced any oscillation of Claude's manometer The injection of water does not produce the same instantaneous improvement as on the day before, but the patient ceases to groan and his pupils contract themselves The arterial pressure taken before the injection stood at 15/9, index 25, and drops after it to 14/8, index 2

Six hours after the injection manifest improvement is perceivable, the patient answers gaily the question he is asked, he takes food with relish The pulse has risen to 68 Nine hours after the injection he is found out of bed is feeling gay and cannot understand why he should be ordered back to bed The pulse beats at 76 From this time on the improvement is definitive Lumbar puncture, practised three days later, shows a pressure of 45-50 cm water, after abstracting two c cm of clear fluid, the pressure falls to 35-39 Two days later, the patient leaves the ward, quite well again He has been seen seventeen days after leaving the hospital and enjoyed excellent health

CASE III—The third patient, G H, sixty years old, falls downstairs on January 13, 1925, and is found laying insensible two hours afterwards On arriving at the clinic, the patient answers with difficulty and slowly the questions he is asked He is somnolent, presents some superficial and trivial wounds of the nose and the occipital region He feels no pain Pulse, 76 Reflexes, normal Diagnosis made, slight commotio cerebri

On the next day the patient remains stuporous His state being stationary in the evening, lumbar puncture is practised The pressure as shown by Claude's apparatus is 5 cm water in lateral decubitus, falls soon to 2 cm The puncture needle being left in the spinal canal, 30 c cm of distilled water are injected intravenously, during the injection, the indicator of the manometer shows some oscillations, the pressure rises to 10 and reaches 12 cm It must, however, be noted that it does not keep up and quickly drops to 0 Five minutes later it has not risen again

On the 15th and 16th of January the condition of the patient remains stationary A new injection of 20 c cm of distilled water, practised on the 16th, makes the pressure rise from 15 to 20 cm

On the next day (January 17) the patient feels better, is no more mentally confused, takes even food with some appetite, but on the 18th grows somnolent again A third injection of 35 c cm of water is practised The state of the patient is strikingly changed in the evening, he has come out of his torpor and takes a sensible interest in his surroundings On the next day the patient shows quite normal He is kept under observation for eight days more, till January 28, when he leaves the hospital, quite well again

The analysis of these three cases shows that the three patients exhibited the same symptoms, *viz*, an evident hypotension of the cerebro-spinal fluid, manifest in the first and third case on the very first puncture, in the second case it was definitely found on the third day only, the lumbar puncture on arrival at the clinic having shown a pressure of 40 cm It is evidently difficult

## CEREBRO-SPINAL FLUID HYPOTENSION

to say in this case whether the hypotension observed on the third day after the aggravation of the general symptoms belongs to a post-commotional syndrome of a special type or whether there was a loss of cerebro-spinal fluid through a gap of the dura mater such as could have been produced by the badly constructed puncture needle that had been used for the first exploration

From the therapeutic point of view, our action has been nothing but a fight against the hypotension of the fluid. The nervous symptoms exhibited by the three patients have been rapidly improved and completely cured by intravenous injections of distilled water. The first and second have been transformed by the first injection and remained in a state of equilibrium, the first for about thirty, the second for ten hours; both relapsed into a state of marked sleepiness and mental confusion after this time; the first patient suffering again from cephalalgia and vertigo, the other from vertigo and vomiting with slowing of the pulse. In both lumbar puncture evidenced a renewed fall of the pressure of the cerebro-spinal fluid. The second injection of distilled water cured both definitively, and in one of them, when the puncture needle had been left in the medullary canal while still connected with the manometer, the pressure rose under our eyes from 0 to 12 cm. Finally lumbar puncture was again practised on both some days afterwards, before they left the hospital and showed a quite normal pressure of the cerebro-spinal fluid. The third patient who showed initial pressure of 5 cm that soon dropped to 2, rose to 12 after the injection of a very slight quantity of distilled water, but dropped afterwards back to 0, received no benefit from the first injection of water. For forty-eight hours he remains stuporous and stays without treatment. He then gets in the evening a second injection of distilled water and is better on the next morning, but grows somnolent again the day after, and a third injection of water shows no effect. It is only the fourth and more voluminous injection that definitely gets him out of his torpor.

The facts can therefore not be denied. The rational treatment of acute hypotension of the cerebro-spinal fluid is the intravenous injection of from 30 to 40 c cm of distilled water. The method is at once easy and safe. It may be advisable in order to secure a definitive result to repeat the injection twice or more. It seems indeed that sometimes the pressure becomes only stabilized after two or three hypertensive injections.

The acute hypotension of the cerebro-spinal fluid has rather well-defined clinical features described by M. Leriche. Sometimes there is lasting frontal cephalalgia (such as is seen in certain trephined patients with depressed cicatrix, and after lumbar anæsthesia). The headache can be accompanied with nausea, vomiting and giddiness (second case). There is noted sometimes semi-coma, but more frequently torpor and mental stupor. All these symptoms make one think of an attenuated meningeal state, or even of meningitis, when they are associated as it has already been remarked with



other signs like slight stiffness of the neck, position "en chien de fusil" and Kernig's sign \*

The differential diagnostic of hypotension and hypertension will not therefore meet with insuperable difficulties. In some cases the exact diagnosis may be foreseen clinically even before Claude's apparatus has been applied. The manifestations of hypertension are as a rule more apparent and striking. There is often motor agitation, the pulse is notably slower, hard and tense, the breathing accelerated, symptoms indicating the more or less pronounced irritation of the pneumogastric nerve centre. When there is a more considerable compression, when the bulbar centres begin to get paralyzed, the pulse becomes faint, rapid, irregular, there is slow breathing with stertor. The clinical aspect of hypotension is different in every point from that of great hypertension. To mistake one for the other is impossible. It is only the attenuated traumatic hypertension, with badly defined and incomplete signs, that could lead to a mistake, and this mistake would be easily corrected by an explorative lumbar puncture, which always should be completed by the measuring of the pressure of the fluid.

The clinical criteria we have given appear somewhat uncertain compared with the accurate data that this determination yields and with the criterium "ex juvantibus" constituted by the effect of the therapeutical hypertensive injection.

In this paper we have let the facts speak for themselves without interpreting them and do not construct any theory. We only wish to lay stress on the frequency with which the syndrome of hypertension of the cerebro-spinal fluid occurs in cranial traumatism and the efficiency of the therapy we nowadays apply to it.

Why is this therapy hypertensive for the cerebro-spinal fluid? The question appears intimately involved with the problem of the elaboration of the cerebro-spinal fluid and the upkeeping of its equilibrium. In our experimental work on animals, we have obtained the confirmation of the results gained by Weed and MacKibben. We have been able to raise the pressure of the fluid by injecting distilled water into the blood, but the intimate mechanism of these phenomena that appear so simple in their reality and so easy of observation, remains hidden from us. All we can suppose is that the injection, notwithstanding the apparent want of other reactions, produces a

---

\* The clinical signs of hypotension following spinal anaesthesia can be sometimes very pronounced and bear peculiar features. Severe cephalgia, somnolence, marked stiffness of the neck, very evident Kernig's sign could lead one to believe in infection of the meninges by subdural injection of the anaesthetic. These fears are absolutely unfounded, since these signs are brought about by the hypotension of the cerebro-spinal fluid and vanish within a quarter of an hour after the intravenous injection of distilled water. In two cases, that came recently under our observation, we have witnessed the rapid disappearance of all meningeal symptoms. In both cases a single injection had an immediate and lasting curative effect.

## CEREBRO-SPINAL FLUID HYPOTENSION

modification of the osmotic exchanges between the blood and the cerebro-spinal fluid and that this takes place in the subarachnoidal spaces and in the dialyzing organ, represented to all appearance by the choroid plexus

Further experimental research of the histo-physiological modifications of this organ might throw some light on this interesting question

### BIBLIOGRAPHY

- R. Leriche De l'hypotension du liquide céphalo-rachidien dans certaines fractures de la base du crâne et de son traitement par l'injection de serum sous la peau Société de Chirurgie de Lyon, 17 juin, 1920 Lyon Chirurgical, September, 1920, p 638
- R. Leriche Recherches sur la pression basse du liquide céphalo-rachidien et ses variations provoquées à propos d'un cas d'écoulement post-traumatique de liquide céphalo-rachidien par l'oreille Société de Chirurgie de Lyon, 27 Octobre, 1921, Lyon Chirurgical, mars, 1922
- R. Leriche Sur l'hypotension du liquide céphalo-rachidien Lyon Chirurgical, janvier, 1922, p 56
- Weed and MacKibben. Pressure Changes in the Cerebro-spinal Fluid following Intravenous Injection of Solutions of Various Concentrations American Journal of Physiology, vol xliii, No 4, p 512

# END RESULTS IN NEURO-SURGERY\*

IMPRESSIONS DURING DECADE 1913-1923

BY WILLIAM SHARPE, M D

OF NEW YORK, N Y

PROFESSOR OF NEURO-SURGERY, NEW YORK POLYCLINIC HOSPITAL AND POST GRADUATE MEDICAL SCHOOL

DURING the past two years, I have been reviewing the records and examining the patients operated upon during the decade of 1913 to January the first, 1923. The records of only 73 per cent of these cases could be completed up to date—the greatest difficulty having been encountered in locating the traumatic ward patients and the ambulance cases. My impression of the end-results from the standpoint of the ability of the patient to earn a living and to be a useful member of the community has been discouraging and particularly is this true of those patients having had lesions of the central nervous system, such as brain tumor, brain abscess, chronic brain injuries, and internal hydrocephalus, whereas more encouraging results have been obtained in the operative treatment of trifacial neuralgia, lesions of the spinal cord, brachial plexus and of the peripheral nerves, external hydrocephalus in its milder forms, chronic brain injuries of supracortical hemorrhage, and then, possibly the most gratifying of all, the treatment of acute brain injuries, both in the newborn and in adults. It is the hope, however, that a much more favorable report can be made at the end of the next decade. In searching the literature for detailed reports regarding the end-results in neuro-surgery, it has indeed been very surprising not to find such reports upon any large series of cases—merely reports of individual cases in detail and for a period of only two or three years after operation, and then the grouping together of brain conditions under one heading and considering the operative mortality rather than the end-result from the standpoint of a normal individual, the cerebello-pontine angle tumors of the auditory nerve, and usually benign in character, and the operative relief of trifacial neuralgia, with an operative mortality of less than two per cent, and a permanent relief of pain, can in no way be compared with the seriousness of cerebral gliomata, subcortical abscess formations and the various types of hydrocephalus and chronic brain injuries from the standpoint of future normality—physically, mentally and emotionally.

Within the past twenty years, a tremendous advance has been made in the field of neuro-surgery. There have been three main factors in this development.

First—The pioneer work of men like Horsley, Von Eiselberg, Krause, Chipault, and Chaput, and in this country Keen and Hartley, and then more recently and preëminently, Cushing. At present there is a group of younger men throughout the country all making valuable contributions to this subject.

---

\* Read before the New York Neurological Society, June 2, 1925

The second factor has been a better team-work between the neurologist and the surgeon—the neurologist, by improved methods of examination, is making possible earlier diagnosis and more accurate localization of the lesion, and the surgeon, by understanding at least the principles of neurology and the anatomy of the central nervous system, knows what can be done and what cannot be safely done surgically and in this manner the catastrophes of the past are being avoided. If the condition of the patient cannot be benefited by the operative procedure, the surgeon should by no means make the condition worse. The third factor has been an improved surgical technic whereby the operative mortality has been greatly lessened so that the risk is no greater than that of a major operation in general surgery; the duration of the operations has been lessened almost 50 per cent, the greatest care and attention being given to hæmostasis, and in recent years the use of local anæsthesia for almost all of the operations upon the central nervous system, local anæsthesia not only perfects the hæmostasis, but it lessens the operative shock and this method should be used in every adult case whenever possible.

The neurological conditions amenable to surgery may be divided into two fields according to the end-results obtained—not only the operative result as to life and death, but rather that of ultimate recovery of function, whether the individual becomes a useful member of society again, is able to earn a living, and may be considered as normal after the operative treatment as before the lesion developed. In this respect, the majority of the conditions comprising the field of neuro-surgery are very different in their end-results from the conditions of general surgery, such as in abdominal lesions, the diseased appendix or the infected gall-bladder can be removed and the patient not only regain his former health, but very frequently achieve much better condition of health than before the lesion was suspected, whereas in most of the conditions in neuro-surgery, rarely is the lesion diagnosed early and accurately localized to a degree warranting an operative procedure until long after delicate nerve cells and tracts have been irreparably damaged, so that even with a successful operative removal of the lesion yet the end-result is at most an improvement—by all means a result to be desired and strived for, but rarely can the word “cure” be used; when such a happy result is achieved therefore, it is usually heralded and such cases are reported in the literature to an extent that these successful results are considered much more common than is the case, and indeed it is most rare for a patient having had a neuro-surgical condition to regain his former normality—the chief exceptions being operative cases of trifacial neuralgia, many acute brain injuries, and early peripheral nerve injuries. Besides, many neuro-surgical lesions cannot be removed—the object of the operation being merely to offset the results of the presence of the lesion rather than the elimination of the lesion itself and naturally in these cases an improvement is the most to be expected.

*Discouraging Field*—In my series of cases during the ten-year period of 1913–1923, the most discouraging field in neuro-surgery consists of brain tumor, brain abscess and the condition of internal hydrocephalus.

1. *Brain Tumors*—The discouraging feature of these conditions is not the operative risk as it is the high degree of malignancy of these tumors—not so much to the extent of producing metastases as to their recurrence upon removal and eventually causing the death of the patient. In my series of brain tumor cases, 81 per cent have been malignant, and of my last 14 cases, 12 have been malignant—the 2 benign tumors being, as the first of this series, an endothelioma, the size of an orange, in a twenty-one months' old baby, already blind with a secondary optic atrophy of high intracranial pressure and the last of this series being a large right frontal lobe endothelioma in a man of fifty-four years of age having had convulsive seizures for sixteen years and definitely deranged mentally, so that at most a useful member of the community could not be expected. At present, I have no patient living over three and one-half years following the removal of a malignant cerebral tumor. Even if the tumor is diagnosed early and accurately localized and the tumor should be a benign one, it is only too frequent for such a tumor to be located intracranially in an almost inaccessible situation surgically and in order to remove such a tumor, normal brain tissue must frequently be penetrated and damaged at the time of the operation, so that even should the patient recover from the operation, yet a normal individual cannot be expected—physically, mentally and emotionally. The excellent contribution by Dandy of ventriculography is a most important one, and it does make possible the accurate localization of tumors impinging upon the ventricles by roentgenograms of the injected air, unless the tumor is a small one and closely associated with the ventricles and therefore a deep subcortical one, then the other tumors in order to dent the ventricles must be large if they are to reach the cortex, they must therefore have been in existence for at least months, and even though these tumors are benign and are successfully removed, rarely is it possible to obtain a normal individual. In my experience, if tumors of the motor areas and the auditory nerve fibromata of the cerebellar-pontine angle are excluded, brain tumors at operation are, with few exceptions, large brain tumors and tumors not arising from the dura and the meninges—that is, the cortical and subcortical “true” brain tumors, are invariably malignant tumors, the meningeal endotheliomata of benign character are in reality only brain tumors to the degree of compressing cerebral tissue and are in no way comparable to the seriousness of cerebral tumors. It is fortunate, however, that earlier diagnosis is now possible in these cases, and it is becoming less and less frequent for patients to be referred to the surgeon after vision has been destroyed and the patient has become extremely impaired, both mentally and physically, the more common use of the ophthalmoscope and the accurate measurement of the pressure of the cerebrospinal fluid at lumbar puncture by means of the spinal mercurial manometer together with the findings of ventricular estimation and cisternal punctures—all these methods of intracranial diagnosis have been added to the neurological armamentarium to the great benefit of patient. The operative mortality has been 19 per cent,

2. *Brain Abscess*—This is another discouraging condition and chiefly due to the high mortality; without operation, the mortality practically is 100 per cent., so that the treatment is a surgical one, and yet even with the operative treatment, and even if the cerebral abscess is located (and almost all operations for cerebral abscess are in reality exploratory procedures) and drainage instituted, yet the mortality rate in my series of cases has been 72 per cent. In this connection, I wish to differentiate a "true" brain abscess (one within the cortex or subcortical, and the only ones that can be really termed brain abscess) from the subdural collections of pus so frequently associated with otitic and mastoid disease and well walled-off from the cerebral cortex itself in the form of a localized purulent meningitis; to consider this latter condition as brain abscess is very misleading—its treatment is a simple incision of the dura and the mortality rate is justly a low one, so that to include this type of subdural abscess among those most serious conditions of "true" brain abscess is very confusing and accounts for the low mortality statistics so frequently reported in the literature—from 48 per cent down to even 26 per cent mortality! A definite advance in the surgical treatment of brain abscess and particularly of that most common type of temporo-sphenoidal abscess associated with otitic and mastoid disease is the avoidance of opening the dura through the infected field of the mastoid into the non-infected subarachnoid spaces and cortex in exploration of the location of the abscess and, if the abscess is not found, then the great danger of producing a purulent meningitis, it is a much more rational procedure to locate the suspected supratentorial abscess—its most common site being in the comparatively "silent" temporo-sphenoidal lobe adjacent to the otitic infection, by means of a dural incision through the clean subtemporal route, so that if the abscess is located, it can then be drained through this incision as well as through the mastoid area, and if the abscess is not found, then the patient has not been subjected to the great danger of a purulent meningitis. Besides, the subtemporal decompression will relieve the associated cerebral oedema and will even permit and facilitate the "pointing" of an overlooked abscess toward the subtemporal dural opening.

3. *Internal Hydrocephalus*—Possibly the most discouraging field in neuro-surgery has been the attempts to treat successfully the condition of internal hydrocephalus—a complete blockage of the ventricles either in the aqueduct of Sylvius or at the posterior foramina of Majendie and Luschka of the fourth ventricles by the exudate of a former meningitis or more rarely by the organization-residue of unabsorbed basilar hemorrhage occurring most frequently at the time of birth. To overcome this mechanical blockage of the escape of the cerebrospinal fluid from the ventricles and the avoidance of the resulting ventricular dilatation with its cerebral destruction has been attempted ever since Aristotle first performed ventricular punctures through the open fontanelle as a temporary relief of the condition and with no more success than is now being obtained in this complete type of internal hydrocephalus. One operative method after another has been reported as a "new"

method of treatment and frequently only one case reported as having been so treated—and yet the end-result has invariably been the same—the death of the patient. Besides, by the time the condition is diagnosed clinically, the ventricular dilatation has produced such irreparable cerebral damage that even if the operative treatment were successful in removing the mechanical blockage, yet a normal individual is not conceivable. Fortunately, however, the cases of hydrocephalus so diagnosed are rarely of the complete internal type—in fact, over three-fourths of the cases in my series are the external type—there being no blockage of the ventricles but a blockage of varying degree in the absorption of the cerebrospinal fluid through the walls of the supracortical veins—almost 80 per cent of the cerebrospinal fluid being excreted in this manner and the remainder by means of the sinuses, Pacchionian bodies, etc. This latter condition of external hydrocephalus is frequently due to a former supracortical hemorrhage occurring commonly at the time of birth, and it is this milder type of external hydrocephalus that can be markedly improved by early operative drainage of the blocked cerebrospinal fluid and thus lowering the increased intracranial pressure.

*Encouraging Field*—Fortunately, the encouraging field of neuro-surgery consists of the larger number and of the more frequent neurological conditions amenable to surgery.

1 *Trifacial Neuralgia*—The operative treatment of trifacial neuralgia, after other methods of treatment have failed, is possibly the most gratifying in that the severance of the posterior sensory root of the Gasserian ganglion or the extirpation of the ganglion itself affords immediate and permanent relief, merely severing the second and third branches of the trifacial nerve intracranially at their foramina of exit is of temporary value only and is never performed unless operative complications make it advisable to do so. The mortality in my series has been 2 per cent and is the lowest of all cranial operations—being in reality an extradural procedure.

2 *Spinal Cord Lesions*—A Tumors affecting the spinal cord have been malignant in only 41 per cent of my series. Since the diagnosis of spinal cord tumor is comparatively much earlier and the localization more accurate than cerebral tumors, it is frequently possible to obtain an apparently normal individual in the benign cases, no patient in this series is living, however, having had a malignant tumor removed over five years ago. As in cerebral tumors, true spinal cord tumors—that is, ones arising in the substance of the spinal cord rather than in its covering, are with few exceptions malignant. Only in early cases of small tumors of the meninges where the compression of the spinal tracts has not been prolonged and severe, has it been possible to obtain normal gait and sensation, and the reflexes within normal limits. The operative mortality has been 9 per cent.

B Traumatic lesions of the spinal cord usually associated with vertebral fracture are amenable to marked improvement if there is not present a primary contusion and laceration of the spinal tracts. Spinal cord compression of bone and of extensive hemorrhage should be relieved early for fear

of permanent damage to the tracts. If it is definitely known that the signs of an acute transverse myelitis are due to irreparable contusion, laceration and even severance of the spinal cord and thus a hopeless condition, naturally surgery offers nothing to these patients, but if it is not known definitely that the cord is irreparably damaged, then it is my opinion that these acute patients should be given the benefit of an exploratory laminectomy of spinal decompression and drainage after the shock has subsided, to wait for a period of months in these cases and if sensation returns to the legs or some motor power, then to advise an exploratory laminectomy is merely months late—the ideal time for treatment, as in brain injuries, is during the acute stage and not during the chronic stage, when the improvement, if any, to be obtained becomes less the longer the interval following the injury. In none of these chronic cases has more than a slight improvement been possible. The operative mortality in these acute patients has been 16 per cent.

3 *Peripheral Nerves*—A. In the surgery of traumatic lesions of the peripheral nerves, the best results have been obtained in the end-to-end anastomoses as soon as possible after the severance, that is, the emergency operations. The greater danger of infection in these cases is more than offset by the excellent end-results as compared with the chronic cases. The farther from the spinal cord the anastomosis, the better has been the end result, and yet it was rare to obtain a complete recovery of sensory and motor functions in the chronic conditions. Local anæsthesia has been used and there has been no mortality.

B Traumatic lesions of the brachial plexus occurring at the time of birth are apparently due in a large percentage of the cases to a simple overstretching of the nerve roots of the plexus, so that an early complete recovery of function is possible within three to six months after birth. But in those cases where one or more branches of the plexus are torn and their ends separated, then in many of these cases at least a recovery of function does not occur and the earlier the end-to-end anastomosis is made, the more complete the end result. In my series of 146 operated cases with a mortality of one, there is not one case of complete recovery of function—that is, the affected arm being as normal as the other arm, although the earlier the anastomosis after birth, the better has been the end result. The ideal age for the operative repair is at three months.

C Chronic peripheral facial paralysis due to otitic and mastoid complications, local trauma and chronic cases of the Bell's type, may be improved in selected cases of complete paralysis by the anastomosis of the ipsilateral hypoglossal nerve or better one-half of it to the distal end of the facial nerve as it emerges from the stylo-mastoid foramen. My best result has been only an improvement in the facial musculature and movements—by no means a perfect result. There has been no mortality in 32 cases. Direct anastomosis of the facial nerve itself or the separation of adhesions compressing it in its bony canal, may be attempted in selected cases.

4 *External Hydrocephalus*—These conditions of supracortical obstruction



in the circulation of the cerebrospinal fluid, not in the ventricles of the internal type, but at the sites of absorption or excretion of the cerebrospinal fluid through the walls of the supracortical veins, sinuses, Pacchionian bodies, etc., and thus producing the chronic condition of so-called external hydrocephalus under varying degrees of increased pressure, may be improved by cranial drainage of the partially blocked cerebrospinal fluid. The degree of improvement depends upon the severity of the initial lesion, whether the blockage is due to a diffuse meningitis and meningo-encephalitis in which the prognosis is naturally bad or due to an extensive supracortical hemorrhage with little or no primary damage to the underlying cortex. If, by cranial drainage of the blocked cerebrospinal fluid, the increased intracranial pressure can be lowered to normal, then it is possible for a large percentage of these cases to be improved and the younger the child, the greater is the improvement to be obtained. My series contains 93 of these patients with a 12 per cent mortality.

5 *Acute Brain Injuries—A. Adults* The diagnosis and treatment of acute brain injuries form in my series of neuro-surgical conditions the most satisfactory cases from the standpoint of the end-results to be obtained. A few years ago, these conditions were termed "fractures of the skull," and this comparatively unimportant bony pathology has retarded the diagnosis and the rational treatment of brain injuries for many years—the important findings now being the presence or not of a high intracranial pressure of hemorrhage or of cerebral œdema. Gross laceration of cerebral tissues was not a frequent post-mortem finding in my series—6 per cent only, whereas supracortical hemorrhage and cerebral œdema were most common. In this series of acute brain injuries in adults, now over 1000 cases, the expectant palliative treatment was satisfactory in over one-half of them—56 per cent—there being no marked increase in the intracranial pressure, at least not over twice the normal, and where the expectant palliative treatment of absolute quiet, ice helmet, shock measures, etc., sufficed, aided in selected cases having a mild increase of the intracranial pressure by repeated lumbar punctures of spinal drainage. The use of magnesium sulphate and sodium chloride solutions to lower high intracranial pressure in these traumatic cases has not been satisfactory in my series, but it has been of great value in the chronic cerebral œdemas associated with tumor formations, etc., this latter condition is more a true intracellular œdema rather than the "wet" œdematous condition of the brain so frequently present in the traumatic cases. The operative treatment to lower an increased intracranial pressure was deemed advisable in only 30 per cent of the cases—only when a marked depression of the bony vault was present or when the intracranial pressure was over twice the normal—above 16 mm of mercury. The total mortality was 39 per cent and if we subtract the 14 per cent of moribund cases—those patients entering the hospital and dying within six hours after admission from shock, medullary œdema (decompensation), other internal injuries and for whom no operative treatment was naturally advised, then the mortality is lowered to 19 per cent. The operative mortality was 38

per cent, and these were the patients more seriously injured not only from the standpoint of recovery of life, but of future normality

In the operative treatment of acute brain injuries, there are two periods in which *no* operation should be performed, and it has been the neglect of this fundamental consideration that the operative treatment of selected cases of brain injuries had become almost discredited. The first period in which no operation should be performed is during the initial stage of shock, when the temperature is subnormal and the pulse and respiration rates are above 120 and 34, respectively, and the blood-pressure below 100. To advise a cranial operation or even extensive prolonged examinations and tests upon these patients in the condition of severe shock merely lessens the chances of recovery, and if the patient does survive, then he recovers in spite of the additional shock of the examination and of the operation.

The second period during which no operation should be performed may be termed the terminal one of medullary œdema (decompensation), characterized clinically by rapidly increasing pulse and respiration rates and rising temperature, but by a falling blood-pressure. The patient may have been "doing well" for a period of several days and then he changes rapidly, so that the picture approximates the clinical syndrome as described above and then, since it is feared the patient will die, it is often thought advisable "to give him a chance;" but these patients all die, having the condition of medullary œdema, whether operated upon or not—the operation merely hastening the exitus.

However, in the treatment of patients having acute brain injuries, their intracranial status can be accurately estimated by repeated lumbar punctures, using the mercurial manometer and by frequent ophthalmoscopic examinations and in this manner the late clinical signs of medullary compression, such as retarded pulse- and respiration-rates and a possible increasing blood-pressure, can usually be anticipated and thus the dangerous condition of medullary œdema be prevented by the rational treatment of early subtemporal decompression and cranial damage in that small percentage of selected cases having a high intracranial pressure (less than one-third of all cases). The use of repeated punctures of the cisterna magna for the drainage of subtentorial hemorrhage with definite signs of medullary compression may be of great value in selected cases.

**B Children**—The diagnosis and treatment of acute brain injuries in children under sixteen years of age are the same as in adults, except that the operative method of treatment to lower a marked increase of the intracranial pressure due to hemorrhage or to cerebral œdema is much less frequent, owing to the fact that acute cerebral œdema following cranial injuries in children occurs comparatively rarely. Apparently the intracranial vascular mechanism of the child adjusts itself much more rapidly and easily to the effects of cranial trauma, so that an increased amount of cerebrospinal fluid is either not secreted or, if secreted in large amounts, then the excess is absorbed without difficulty, so that the condition of acute cerebral œdema only occurs in the

extreme cases For this reason, the operative treatment of acute brain injuries in children has only been necessary in 16 per cent of the patients, whereas in adults the operative treatment was advised in 30 per cent It may be stated also that children will stand the effects of brain injuries much better than adults, and I believe this is also due to the less frequent occurrence of extensive cerebral œdema in them

C *Newborn*—For years the acute condition of intracranial hemorrhage of the newborn has been a pathologic study of post-mortem findings rather than their clinical recognition and, therefore, limited to a consideration of gross lesions and of extreme forms of intracranial hemorrhage of sufficient amount to cause the death of the baby One hundred years ago, Denis, Billard and Cruveilhier wrote that one-third of the deaths of the newborn were due to intracranial hemorrhage After Little described his findings, in 1862, and McNutt, in 1885, confirmed this opinion of the relationship of intracranial hemorrhage of the newborn and cerebral spastic paralysis, very little attention to this subject of intracranial hemorrhage in the newborn was given in the literature, until the last decade when a greater interest has been aroused Numerous investigators of the post-mortem findings, particularly Warwick, Capon and others, have stated that at least 50 per cent of the deaths in the newborn were due to a gross intracranial hemorrhage, resulting from a rupture of the tentorium, falx, large sinuses, and of the supracortical tributaries of the longitudinal sinus, etc And then the clinical observations of Sidbury, Brady, Green, and others, have added to the clinical picture of a condition, the recognition of which, Huenekens states, is the most neglected phase in the care of the newborn and yet the most important one

During the ten-year period of 1913 to January 1, 1923, I had the opportunity of examining in consultation and treating 46 newborn babies within the first two weeks, the diagnosis being a serious intracranial lesion, most probably hemorrhage following a difficult labor, with and without the use of instruments The acute condition of these children was considered of such grave character that early death was feared and it was hoped that possibly a cranial operative procedure might offer the child a chance of recovery of life, at least Lumbar punctures were performed on all but two (these two having died before tests could be performed) and free blood, under varying degrees of increased pressure was found in the cerebrospinal fluid of 87 per cent of these patients, tested during the first week after birth During the second week, and especially later, the lumbar puncture becomes of increasingly less value as a diagnostic aid, the fluid blood usually coagulating within the first ten days Repeated lumbar punctures of spinal drainage were used in four of the milder and earlier cases within the first week, with the hope that the intracranial hemorrhage could all be drained in this simple and safe manner, but in only two of them, after four and seven lumbar punctures, respectively, every twelve hours, did the fluid become clear and of normal pressure

This method of spinal drainage should be attempted in all but the very extreme cases of extensive intracranial hemorrhage, under high pressure,

within the first week after birth. If the cerebrospinal fluid does not become clear or the pressure become normal and remain normal, then the cranial operation of modified subtemporal decompression and drainage should be considered. The operative and post-mortem findings in 100 per cent of these acute extreme cases disclosed subdural, supracortical and subarachnoid hemorrhage of varying degree. If not of sufficient amount to cover the convolutions, then the free blood was found in the sulci about the supracortical veins and always associated with a high degree of cerebral oedema. Of these 46 cases, 29 died with and without operation. Seventeen babies lived, and of these 8 are now apparently within normal limits, physically and mentally, whereas 9 are definitely impaired both physically and mentally, of these 9 children, 6 were operated upon during the second week and 3 upon the fourth, fifth and seventh days, respectively. It must be remembered that these were serious cases of extensive intracranial hemorrhage and were not operated upon until several days later, when it was considered that the baby was going to die, the ideal time, as we now know, for the spinal drainage of repeated lumbar punctures is as soon as possible after acute intracranial condition is definitely diagnosed.

In this connection, it may be of interest to record the frequency of intracranial hemorrhage of varying degree in the newborn as registered by routine lumbar punctures within twenty-four to forty-eight hours after birth in a series of 500 consecutive newborn babies at the City Hospital, Manhattan, during the past two years.\* These observations were made with my associate, Dr. A. S. MacLaire, and it was most surprising to find bloody and blood-tinged cerebrospinal fluid in 45 babies—that is, in 9 per cent. Repeated lumbar punctures of spinal drainage were made until the cerebrospinal fluid became clear and under normal pressure—the average number being three punctures. Three of the babies died and each autopsy disclosed supracortical hemorrhage and cerebral oedema of varying degree. Less than one-half of these babies evinced signs indicative of an intracranial hemorrhage, the signs, when present, were drowsiness to stupor, difficulty to refusal to nurse, and twitchings of orbital muscles and fingers to general convulsive seizures. The blood-clotting time was not lengthened in a single case, so that the factor of hemorrhagic disease of the newborn, in this series at least, seems almost a negligible one, unless in its so-called “latent” form, whereas both trauma and asphyxia are apparently the more common etiological factors.

*Chronic Brain Injuries—A. Adults.* It has become quite a common expression among the laity, that “once a person has had a fracture of the skull, then that person is never the same again.” To a large extent this impression is a correct one, at least it was so during the period of over ten years ago, when the attitude of the medical profession was concerned merely with the recovery of life of the patient rather than the return to complete functional normality. In the absence of gross cerebral lesions of the brain

---

\* These observations were presented to the American Medical Association at its meeting in Atlantic City, in May, 1925, and will be published in detail in the *Journal of the American Medical Association*.

as a cause of death in a large series of consecutive autopsies of patients dying from cranial injuries during the four-year period of 1912 to 1916 in Bellevue Hospital, and the demonstration in these cases that the usual findings were "wet" cedematous brains associated or not with varying degrees of hemorrhage along the sulci about the supracortical veins, it was most interesting to study the clinical records of four of the large hospitals in New York City of their patients having had cranial injuries during the decade of 1900 to 1910. The total mortality ranged from 46 to 64 per cent., the operative mortality being as high as 87 per cent., due to the operation being performed during the two periods when *no* operation should be even considered.

This study was made in the year 1912. Only 34 per cent of the patients discharged as "well," "cured" and "improved" were located, but of these patients 67 per cent were not well and were still suffering as the result of the cranial injury, the chief complaints and signs being headache, dizziness, early fatigue, change of personality to the depressed or irritable type and in a small percentage of them convulsive seizures. It was rather surprising to find in a large percentage of these patients evidences of an increased intracranial pressure, as disclosed both by the ophthalmoscope and by the lumbar puncture, and thus indicating the chronic condition of cerebral oedema. At operation even at this late date after the injury or at autopsy, there was disclosed an cedematous, "wet" brain under varying degrees of increased pressure and along the supracortical veins in the sulci was exposed a cloudy, whitish new-tissue formation—the organization-residue of a former layer of supracortical hemorrhage which could not be absorbed through the normal channels of excretion—the stomata of exit in the walls of the supracortical veins, through which almost 80 per cent of the cerebrospinal fluid is normally excreted. It is this organization-residue which causes a partial blockage in the normal absorption of the cerebrospinal fluid, and thus the resulting "wet" cedematous brain under varying degrees of increased intracranial pressure—the organic basis for many of the symptoms and signs occurring in patients having had a cranial injury, as headache, dizzy spells, early fatigue, change of personality and even convulsive seizures themselves, all of these symptoms and signs being due to cranial pressure rather than to a gross cerebral lesion, such as lacerations, cortical hemorrhage, etc.

*Post-traumatic Neurosis*—In this connection of chronic brain injuries, the condition of post-traumatic neurosis is one that must always be considered—a functional condition to be differentiated from an organic one. In post-traumatic neuroses, the emotional factor of fear and shock at the time of the injury is to be remembered, together with the constitutional make-up of the patient, whether neuro- and psychopathic or not, and also in a large percentage of these cases, the factor of hope of damages to be obtained, this latter complication being frequently an all absorbing one. If a legal suit is pending, it is not possible to improve the condition of these functional cases by any known method of treatment, after the suit is settled, and especially if satis-

factory to the patient, these are the patients having functional conditions which improve very rapidly and usually within months or one year following the injury. However, no such patient should be considered as having a functional condition of neurosis without careful neurologic examinations having been made, and in each case competent ophthalmoscopic examinations and a lumbar puncture with an estimation of the pressure of the cerebrospinal fluid as registered by the spinal mercurial manometer, so that it is definitely ascertained that there is present no increase of the pressure of the cerebrospinal fluid. Otherwise the patient, having an increased intracranial pressure of chronic cerebral œdema and thus an organic basis for the symptoms and signs, may be incorrectly diagnosed, for these patients having organic lesions do not "clear up" and improve following a mere satisfactory settlement of the legal suit. These organic cases are ones now being frequently overlooked and neglected under the classification of post-traumatic neurosis.

*B Children*—In 1913, I became interested in the chronic condition of cerebral spastic paralysis and, in taking careful histories of a large series of patients at two of the orthopædic hospitals of New York City, and then by thorough neurologic examinations including the routine ophthalmoscopic and lumbar puncture tests, it was surprising to note that in a small percentage (12 plus per cent) of these patients there were evidences of an increased intracranial pressure of chronic cerebral œdema. Occasionally, in a very small number of the older patients, the X-ray disclosed evidences of convolitional markings of the inner table of the vault, due to its atrophy resulting from the prolonged increase of the intracranial pressure.

The history of these chronic patients having the condition of cerebral spastic paralysis is rather instructive. During the past ten years, up to January, 1923, I have examined personally 5192 children, and of this total number examined, 671 (12 plus per cent) have had an increased intracranial pressure as disclosed at lumbar puncture. The operative and post-mortem findings have revealed "wet" œdematous brains under varying degrees of increased pressure, and along the supracortical veins in the sulci was a whitish cloudy new-tissue formation, reported pathologically as being the organization-residue of a former layer of hemorrhage which had occurred most probably at the time of birth. Gross cerebral lesions of intra- and subcortical hemorrhagic cysts, old cerebral lacerations, etc., were disclosed in only 6 plus per cent.

The histories revealed the following data: 81 per cent first children; 72 per cent males; 95 per cent full-term babies, 90 per cent difficult labors, 76 per cent forceps used as last resort; 17 per cent breech deliveries, in 8 per cent pituitrin had been used.

During the first week, the following observations had been made: 64 per cent more drowsy and stuporous than normally; 23 per cent refused to nurse, 78 per cent evincing a lessened normal demand for food; 39 per cent muscular twitchings, especially of orbital muscles and fingers, in 17 per cent

general convulsive seizures occurred, in 18 per cent an icteroid appearance was present

Within two weeks after birth, 61 per cent were considered well and normal, if indeed anything abnormal had been suspected. Within one month after birth, 82 per cent were considered normal.

Within the first year and usually around the seventh month after birth, 79 per cent of the children were not developing as they normally should, such as holding up the head and later beginning to sit up, and at this time, within the first year, the development of spasticity of varying degree and type was usually observed. Later the child did not walk or learn to talk within the usual time, and it was this development of a chronic condition in an apparently normal child that was most mysterious, to say the least, and its presence was ascribed to almost every possible cause. In this connection, I may state that the Wassermann test of the cerebrospinal fluid was positive in only one-half of one per cent.

*Treatment*—The treatment of this chronic condition of cerebral spastic paralysis depends entirely upon the presence or not of an increased intracranial pressure. (a) Without a definite increase of the intracranial pressure and, therefore, the cerebral damage having already occurred, the treatment is limited to the various orthopædic measures and to mental training. To lessen the spasticity, numerous peripheral nerve operations have been devised, and recently even the severance of the paravertebral sympathetic ganglionic chain—an operative procedure of no real value in my six cases. (b) With a definite increase of the intracranial pressure, if this increased pressure is not over twice the normal (the normal being 6–8 mm Hg), thyroid and thymus therapy may be tried in the hope that this mild increase of the intracranial pressure can be lowered to normal by lessening the amount of the cerebrospinal fluid secreted. However, if the increased intracranial pressure is over twice the normal, the operation of subtemporal decompression and cranial drainage may be considered, in the hope that a sufficient amount of the blocked cerebrospinal fluid can be permanently drained in this manner and thus a definite lowering of the increased intracranial pressure be effected with a resulting improvement of the child's condition, both physically and mentally.

The operative and post-mortem findings in these selected chronic cases of cerebral spastic paralysis have been practically the same as disclosed in the chronic cases of brain injuries which have occurred in adults and in young children, and the original pathology is apparently the same in these cases—a supracortical layer of hemorrhage of greater amount than can be normally absorbed through the walls of the supracortical veins, its collection in the sulci about the supracortical veins and the subsequent formation of an organization-residue of the hemorrhagic clot and thus the resulting partial blockage in the normal absorption of the cerebrospinal fluid, producing "wet" oedematous brains under varying degrees of increased pressure. The younger the child at the time of the development of this increased intracranial pressure, and particularly, therefore, those cases due to an intracranial hemorrhage at the time of

birth, the greater will be the physical and mental retardation and the more marked the condition of spastic paralysis and mental retardation. The older the patient at the time of the intracranial hemorrhage, as in adults, the less marked are the gross physical and mental impairments, but the more marked are the subjective complaints, such as headache, dizziness, early fatigue and changes of personality and the greater are the emotional and psychic impairments.

The prognosis in the treatment of these chronic patients depends chiefly upon the age of the patient and the severity of the intracranial lesion. The younger the child at the time of the lowering of the increased intracranial pressure, the greater the improvement to be expected, but not one of these chronic patients can be expected to become normal as though the hemorrhage had never occurred, no matter what the treatment, because the treatment of these chronic conditions is always a late treatment. The ideal time for the treatment of brain injuries of the newborn, just as in brain injuries of adults, is at the time of the acute condition, when the intracranial hemorrhage itself can be drained—in the adults after the period of initial shock has subsided and in the newborn within a period of one week.



## SURGICAL TREATMENT OF EPILEPSIA PARTIALIS CONTINUA (KOJEVNICKOVI)

BY N J BERESNEGOVSKI, M D

PROFESSOR OF SURGERY, TOMSK UNIVERSITY, SIBERIA

EPILEPSIA PARTIALIS CONTINUA was described for the first time in 1894, by Professor Kojevnickov, and at the same time by Professor Bruns under the name of myoklonia cum epilepsia. The greater number of cases of epilepsia partialis continua has been described by Russian medical men—less by foreigners. This malady can be frequently met in Siberia. Thus Professor Omorokov described 27 cases, which were observed in Tomsk's clinics during three years, while in the medical literature of the world up to 1922 there were described only 12 cases.

The main symptoms of this disease are (1) Continual excitement, which is expressed in continual convulsions and (2) a local affection, manifesting in convulsions confined to particular groups of muscles, which convulsions do not extend to the other groups.

The pathology of this disease is not completely explained up to the present time. Choraschko and some foreign authors found some changes in the subcortical substance of the brain, while others, Kojevnickov, Omorokov, think that the primary changes are in the cortical substance.

In isolated cases of this disease some authors found affection of a specific character, thus syphilis (Strumpell), tuberculosis and cystocercus (Omorokov). In the greater number of cases some authors found changes in the form of organic inflammation—encephalitis in different stages of development.

According to the materials received after operations, which were performed in the Chirurgical Clinics of Tomsk University, Professor Omorokov gives a detailed account of microscopical changes in the cortex in this disease.

It is observed that the blood-vessels in epileptics suffer very much. Their walls become thicker, they are infiltrated by lymphocytes, leucocytes and plasmodium cells, the endothelium becomes dilated and in many parts contains vacuoles. The cortex of the brain becomes thinner and sclerosed. Ganglion cells in some cases become dilated, the nuclei of these cells have eccentric positions, Nissl's bodies become separated—in other cases cells are small and their nuclei fall to pieces.

There is observed a great development of glia tissues, presence of many giant cells with various inclusions in them. Nerve fibrils are found to be in different kind of degeneration with the necrosis of myelin substance.

In the nerve tissue there are a great many products of regressive metamorphosis of different kind of lipid changes. The progress of the malady is limited. Inflammation is situated only in one locus, as in adjoining places

is found healthy nerve tissue. No specific microbe has been found for Kojevnickov's epilepsy

It is a very interesting fact that this disease is met very often in the north of Siberia, while in Europe it is comparatively rare. Village inhabitants are chiefly attacked with this disease. Probably the cold climate of Siberia plays some part in the etiology of it. Young persons, not older than thirty years of age, are chiefly affected.

Hereditary syphilis is often marked and alkoholismus. Recent syphilis usually is not found. The Wassermann test gives negative results.

The beginning of the illness is usually acute. The temperature suddenly rises. The patient falls into an unconscious state. If the illness does not end by death and the person recovers—attacks of epilepsy appear in different forms. In one class of cases after the acute period there are paralyses of some parts of body, which gradually become feebler, while convulsions of particular groups of muscles begin to develop.

In other cases local convulsions appear suddenly after the acute period. And in a third group of cases the patients, after the acute period, seem to be recovered from illness, but after some time convulsions appear. Sometimes local convulsions are preceded by the general attacks of convulsions of epilepsy.

The main symptoms of Kojevnickov's epilepsy are continual convulsions of particular groups of muscles. As, for example, convulsions confined to one of the limbs. Seldom are convulsions observed in a larger part of body, as half of it. But if the latter happens, still, we can observe convulsions in particular groups of muscles of it. This shows the localization of the process. If the convulsions begin they do not stop even when a person is asleep. During psychic stimulation, as when some one draws attention to a patient or when a medical examination is taking place—the convulsions are usually exacerbated. When a patient is calm the convulsions grow less strong. These continual convulsions exhaust the person very much. To smoothe them a little patients resort to different kinds of forcible measures. Thus a patient seizes with a healthy hand the ill one; if the convulsions attack a leg, the patient crosses his legs and presses strongly the ill one with the healthy one. In the most cases the convulsions are accompanied with pain.

In spite of the strenuous work of the muscles of the affected limb, not very seldom we can notice atrophy of them. For example, in one of our cases the thickness of a healthy shoulder was 28 cm while the ill one was 21. The difference seems to be a great one. Pain from the sting of a pin and the sensation of touch do not suffer in this disease. Sometimes arbitrary pains in the ill limb are observed.

The local convulsions periodically change into total convulsions of epilepsy. The frequency and the quality of the convulsions are not the same in many cases. In some cases they occur once or twice a month, in others sometimes every day. The psychic of patients in most cases is lowered.

The treatment of a patient with epilepsia Kojevnickov may be thera-

peutical as well as surgical. In therapeutical treatment the administration of preparations of bromium sometimes lowers the convulsions. The giving of hydrargirum does not do any better.

Therefore, the surgical treatment is left for us. The latter is used in two forms: as a decompression operation and for removal of cortical centres. A decompressional operation we undertook in one case of Kojevnickov's epilepsy, where the convulsions were expended on the right upper and the lower limbs and on some parts of the face and neck, and moreover total convulsions of epilepsy often were observed. The convulsions in this case were distinctly manifested in the right hand, here we could notice feeble convulsion on the left side of the face about musculus orbicularis. Of course in such a case we could not possibly rely upon the radical recovery after removal of all cortical centres. It would be necessary to remove all motor centres in the left hemisphere. In this case we determined to confine ourselves to a decompression operation by making an aperture in the cranium. In the regio temporalis of the left side of the cranium a semicircular incision was made. The bone and dura mater were removed to the extent of  $3 \times 3$  cm. The skin and muscles flap was then closely sewed up.

The post-operation period ran smoothly. The convulsions became feebler, the total attacks of convulsions become somewhat more rare. But such periods of temporary improvement had been observed before the operation. Therefore it is very difficult to say whether the operation itself brought any improvement.

The second more radical way for operation is removal of cortex centres.

The meaning of this last operation is different according to what theory of localization of process from pathological sight of view, we adopt, whether to that of Choraschko, who thinks that the process is placed in the sub-cortical substance or to that of Kojevnickov's, who thinks that in this illness the cortical substance is affected. In the first case by removing cortical centres, we break up motor apparatus and therefore destroy that battery which sends impulses for convulsions. Breaking up the apparatus we stop convulsions though we do not remove the affected place. In the second case, removing the cortical centres we remove the affected places, therefore from this viewpoint the indication for operation is complete.

There is undoubtedly an indication for removal of cortical centres, where at the base of the illness there is a cystocercus, seated in the cortex, as we observed in one case (No. 2). Here the removal of the cystocercus is the removal of the cause of the illness. The technic of trepanning is well known to every one, and so I shall say few words about some details of it.

The direction of Roland's fissure was determined by the well-known methods. It was marked with a line of nitrate of silver. Such a line does not disappear after applying to the skin tincture of iodine. Hemorrhage from the vessels of the skin was stopped by Heidenhain's method. A piece of bone in form of quadrangle,  $6 \times 8$  cm, is cut big enough to examine the suspected locus. We use Doyen's phrese and Dalgren's tongs. A hammer and

## EPILEPSIA PARTIALIS CONTINUA

chisel we never use. The dura mater we open in the form of the letter H. By such a form of opening the dura mater we do not wound sinuses. The transverse cut is made in space entirely free from bone. It is necessary to be careful when continuing a cut upwards not to wound the longitudinal sinus. If, by any case happens such a misfortune, particularly when the lateral branches of the sinus lie very far away, it would be necessary to put in a suture. If these cut through, we have used in three cases with success, a tamponade with piece of muscles. The arachnoid veins we tie with fine ligature.

The epileptogen zone was located by bipolar electrodes after the method of Rasosmoski. Muscular convulsions as a reaction in the affected limb were very rare. There was no one case in which we could not localize an epileptogen zone by this method. We never excite in using it a total epilepsy.

Further, we note the boundary of this zone. This place on the cortex we mark by a scalpel and remove it in a whole piece, simultaneously removing cortical substance, lying deeper in the sulci of the brain. After removing the piece we examine again adjoining places and the bottom of the wound whether any parts of cortex remain. If such parts are discovered, we remove them with a sharp curette or a scalpel. It is necessary to give special attention to the removal of all affected portions of cortex. If this is not done, in course of time it would be necessary to re-operate, as was observed in Prof. V. N. Sabrin's case (Omorokov).

It is not easy to reach the foot centre that lies on the very summit of the brain and goes behind the internal side of the hemisphere, lying near to the lateral and central part of the longitudinal sinus. Thus Professor Misch (Tomsk) in one case of athetosis could not remove the whole centre of the lower limb and therefore he made other operations on peripheral nerves, dividing them.

For removing the feet centres we use the following method. So that not to open the longitudinal sinus, the cut in the dura mater should not extend beyond 1 cm. from the middle line. Then in the dura mater and its processus falciiformis we apply a wide retractor, with which we expose the brain and proceed to cut out the superficial portion of the cortex, and deeper between both hemispheres. When examining the centres with the electrodes, care should be taken not to make contact with a retractor.

To transplant pieces of fat on the affected cortex is not necessary because the high pressure in the cranium makes a good level of an excavation. We have used a transplant of fat only once.

Then we put pieces of the dura mater in place and join them with fine sutures. Then the bone is replaced and the skin sewed closely.

Surrounding haemostatic sutures (Heidenhain), we take away on the fourth to fifth day after operation. The other skin suture on seventh day.

As a rule in all our cases we have made operation in one stage except in a case in which we wounded the longitudinal sinus, here we made the operation in two stages.

We have operated in cases of Kojevnickov's epilepsy in seven cases by this described method. All these patients were referred by L I Omorokov and R N Favodovski, to whom I express my thanks. The pathological microscopical materials after operations were examined in the laboratory of the Clinic of Nerve Diseases of Prof L I Omorokov.

The removal of the cortical centres in epilepsia Kojevnickov appears by itself, an operation not very objectionable on account of its results. With this operation we try to cure a patient suffering from convulsions, but paralysis of some parts of the body is left after the operation. The question is what is better for him, continual convulsions or paralysis? It seems to us that this question should not have two answers. Continual convulsions with epileptic attacks entails great suffering and so exhausts a patient that a paralysis of one of the limbs appears to be much better. A patient suffering with epilepsy does not only lose a limb writhing in convulsion, but a healthy one with which he tries to keep in quiet the ill limb.

After removal of cortical centres we usually do not find full paralysis. After some time the limbs regain some movement. The flexors begin to work sooner than the extensors. Big joints begin to work before the small ones. The extent of the movement at first is very slight, diversion of the later ones are limited. Mimic of the face and more fine movement of fingers usually are not restored.

The question is why the paralysis begins to lessen. Two suppositions are probable: first, there is some cortical substance left, or neighboring parts of cortical substance compensate the work of destroyed centres. The latter supposition seems to us more probable than the first one, for at the present time it is said that there is no strictly limited localization for centres and that adjoining parts can compensate the action of near-lying centres.

In the most of cases during the operation we found high pressure in the cranium and absence of pulsation, sometimes pushing out of the brain from the trepanning aperture. From this point of view trepanning can serve as a means of regulating intracranial pressure.

The vessels of the cerebral tissues in our cases were usually dilated, in some cases there were commissures between the dura mater and the arachnoid, showing an inflammatory process—meningo-encephalitis—which latter was confirmed by microscopical researches.

Recovery after removal of cortical centres by Omorokov is in 41.66 per cent.

To appreciate final results is an impossible thing because the patients are not investigated closely enough. The low culture of Siberian inhabitants and the great distances make impossible the obtaining of information of their health.

Out of eight cases, in three we had good results. The total epileptic attacks and the local convulsions disappeared, but sometimes, although not often, we could observe slight tremor of separate groups of muscles, so we do not say that they recovered from their illness totally. To a second

No	Age, sex	Preceding illnesses	Length of illness	Hereditary	Localization of convulsions	Frequency and strength of epileptic convulsions	State of muscles of affected organ	Method of operation
1	M 25	Malaria, railway catastrophe	2 years	Sane	Left hand and a little on left leg	Once a month	Considerable atrophy	Removal of centres in one stage
2	M 22	No	1 year	Sane	Left hand	Attack in no fixed time	Great atrophy	In two stages Opening dura mater
3	F 11	Typhus, angina, cold	1 year	Sane	Right hand, face or tongue	Seldom	Atrophy of middle degree	In one stage
4	M 19	Typhus	8 months	Alkoholismus	Hand and foot	Frequent	Great atrophy	Same
5	M 27	Wounded many times, alkoholismus	1 year 2 months	Sane	Hand	Seldom	Same	Same
6	F 20	Childbed eclampsy R Wassermann+	2 years	Epilepsia	Hand, regio humeri, facemus centre costalis diaphragm, sometimes foot	Frequent 2 or 3 times a month	Considerable atrophy	Same
7	M 16	Typhus, pneumonia	2 years	Alkoholismus	Leg	Frequent once in 2 days	Same	Same
8	M 20	Typhus	2½ years	Same	Hand	Frequent	Same	Same

We have  
described  
R N Far  
scopical n  
Clinic of

The re  
itself, an  
operation  
of some  
is better  
this quest  
tic attack  
of one o  
epilepsy o  
with whic

After  
After sor  
sooner th  
ones T  
later one  
usually a

The c  
probable  
cortical  
suppositi  
time it is  
adjoining

In th  
cranium  
the trepa  
means o

The  
some cas  
showing  
confirme

Recc  
per cent

To a  
not inve  
the gre  
their he  
Out  
attacks  
often, v  
we do

Period post-operation	Length of observation	Result
Smooth	4½ years	Improvement Not very big convulsions in hand once in 2 weeks Total epileptic attack after 3 years post-operation
Smooth	1 year	Good
Same	35 days	Improvement
Same	45 days	Not very great improvement
Effluxion of liquor cerebro-spinalis	3 months	There were no total epileptic attacks Local appeared sometimes
Same	1 month	No better
Smooth	1½ months	Good
Smooth	1 month and 7 days	Good

## EPILEPSIA PARTIALIS CONTINUA

group we refer two cases where we obtained considerable improvement. The total epileptic attacks disappeared, the local convulsions did not disturb the patient as much as before, but yet they did not disappear entirely. The patients could do any work after the operations.

In two cases we did not obtain much improvement. The total attacks became feebler, but the local convulsions were unchanged. And in one case we had not any improvement at all.

It is necessary to give attention to the extent of the process. Good result we have in those cases where the process is limited. In one of our cases the convulsions were only in one hand, in another in foot only. (See No 2 and 7.)

The result is worse when many centres are touched: lower and upper limbs, hand or arm, and face. (Nos. 3 and 4.)

No effect was obtained in case No 6, where all the motor centres were affected. Here, in spite of wide removal of cortical centres (3 c cm) it was impossible to obtain a good result. In such cases, it may be better to make only a decompression operation.

### CONCLUSIONS

In conclusion of all above said, we may say

(1) It is necessary to remove motor cortical centres in epilepsy Kojevnickov.

(2) Results after operation in many cases depend upon the extent of the process; if the convulsions affect many muscles, the result is worse.

(3) It is necessary to remove cortical centres in a whole piece. The better results therefore are to be had after cutting with scalpel, but not after scraping with a curette.

(4) It is better to make an operation in one stage; the operation of trepanning could not be considered as a difficult one, if one possesses good technic.

(5) To separate an operation into two stages may be recommended in the presence of complications, such as hemorrhage.

(6) The results of our cases we cannot consider to be cleared up, for most of them have not been traced long enough.

(7) The final impression is that we get undoubtedly by operations some relief for total and local convulsions.



## PERIARTERIAL SYMPATHECTOMY \*

BY IRA COHEN, M D

OF NEW YORK, N Y

IN 1913, Leriche<sup>1</sup> advocated the use of an operation first described by Jaboulay in 1899, and which is now known as periarterial sympathectomy. This procedure consists in the removal of the adventitia of an artery over a varying length, which is followed by immediate changes in the operated limb, contraction of the exposed vessel, subjective and objective coldness of the extremity and diminution of the peripheral pulse. These changes last several hours and are followed by signs of dilatation of the peripheral vessels with subjective and objective increase in temperature and elevation of the arterial pulse pressure. These latter phenomena last five to six days or even longer. Leriche recommended this operation in the extremities for the relief of pain due to vascular causes and claimed that the ulcerations of vascular or trophic origin were benefited. He assigned as a reason for the beneficial results the interruption of the sympathetic innervation of the vascular system distal to the site of operation.

Leriche's observations of the vascular changes locally and distally, as well as clinical improvement, have been confirmed by numerous observers, but the explanation is not as simple as that advanced by him. From an anatomical standpoint Potts<sup>2</sup> demonstrated that the nerve supply to the main arteries of the leg is derived from nerves given off to them at various levels along their course, and the smaller radicles are innervated from sympathetic plexuses on the walls of neighboring parent vessels. Kramer<sup>3</sup> showed a similar arrangement to exist in the arteries of the arm. From a physiological standpoint Langley,<sup>4</sup> in the course of some other work, showed that the usual blanching of the pad in the cat's foot obtained on stimulation of the lumbar sympathetic trunk, gradually grew less and finally ceased when one after another of the peripheral nerves of the leg were divided. Thus from the anatomical and from the physiological viewpoint we are forced to conclude that the nerve supply of a peripheral vessel is not directly interfered with by an operative procedure on a parent trunk. I say directly, for obviously it is influenced in some manner. The immediate peripheral blanching and the fall in temperature, though not likely, might possibly be accounted for by the local contraction in the operative field, but the marked and persistent vasodilatation which succeeds the primary contraction has not been satisfactorily explained. Thus it will be seen that the procedure is entirely an empiric one.

This paper deals with a report of periarterial sympathectomy performed in eleven cases—a series too small from which to draw any final conclusions, but large enough to be of help in evaluating the procedure.

---

\*From the service of Dr Charles A. Elsberg, at Mount Sinai Hospital, and the author's service at the Montefiore Hospital.

## PERIARTERIAL SYMPATHECTOMY

The technic of the operation performed by me does not differ in its essentials from that described by various other authors. The operation may readily be performed under local anæsthesia. For the femoral artery the site chosen is Scarpa's triangle just below the division of the common into the superficial and the deep femoral arteries. After opening the sheath of the femoral vessels the superficial femoral artery is isolated, exposed and slightly raised from its bed for a distance of five to eight centimetres. An incision with a fine scalpel is made through the adventitia along the exposed vessel. The edge of the cut adventitia is picked up with fine forceps and freed by blunt dissection with a thyroid separator or small cranial elevator. When it has been freed for about a half a centimetre along one side, the adventitia may be grasped with mosquito hæmostats placed at intervals. Gentle traction on these clamps while using the separator will cause the vessel to rotate while the adventitia is thus peeled off until the thin fibrous coat is entirely free from the vessel and may be cut away with scissors above and below. In a few places the adventitia may be found more adherent and it may be necessary to free it by cuts with a fine scissors. After removal of the adventitia the vessel presents a smooth glistening appearance, it is then allowed to drop back into its bed and the soft parts are sutured. In the first few cases operated upon I was not certain that the adventitia had been removed, but the presence of nerve fibres was demonstrated by microscopic examination.

In thromboangiitis a periarteritis exists and the adventitia is very adherent so that, not only is the vessel more difficult to isolate, but in the removal of the adventitia, there is a real danger of injury to the vessel wall.† In the senile arteriosclerotic cases there may be seen after the removal of the adventitia calcareous plaques shining through the media, these vary up to a pinhead in size, or even larger, and occasionally the adventitia is adherent over some of these deposits. In thromboangiitis I have not seen the local contraction of the vessel noted in other cases during and after the stripping of the adventitia.

### SUMMARY OF CASES

CASE I.—Male, aged sixty-one, in Montefiore Hospital, because of pain in the left leg and foot with ulcerations of the leg for thirteen months. He had spent ten months in bed prior to admission. The appearance of the ulcerations is illustrated by the photograph (Fig. 1); his knee was held in flexion by muscular spasm. Neither dorsalis pedis nor posterior tibial pulsation was felt in either extremity. Various therapeutic measures were tried to heal the ulcerations and relieve the pain, but without result. On November 21, 1923, under local anæsthesia, three centimetres of the adventitia of the left superficial femoral artery was removed. The gross appearance of the vessel was normal, and after the stripping, it contracted sharply. Immediately after the operation the left foot was colder than the right; six hours later there was complete relief from pain, the leg was extended at the knee, and both subjectively and objectively the left foot was warmer than the right. Three days later the temperature of both feet seemed the same, but there was no return of pain. At the end of two weeks all the ulcers had entirely healed. Three weeks after the operation the patient developed pneumonia from which he died a week later.

† This happened in one case in the series, fortunately without any untoward result.

## IRA COHEN

This was one of the first cases and one with the most striking result. The patient did not live long enough to determine whether the benefit was lasting, but it was the first time in over a year that he had been free from pain and ulcers.

CASE II.—Male, aged seventy, admitted to the Montefiore Hospital because of pain in both lower extremities of sixteen months' duration. No pulsation was felt in the arteries of either foot and there was impending gangrene of four toes of the right. On December 17, 1923, under local anæsthesia, four centimetres of the adventitia of the right superficial femoral artery were removed, the vessel appeared normal but did not contract. There was no improvement following the operation and a week later the leg was amputated.

CASE III.—Male, aged sixty, admitted to Mt. Sinai Hospital with a six months' history of pain in both lower extremities. On examination no pulsation was felt below

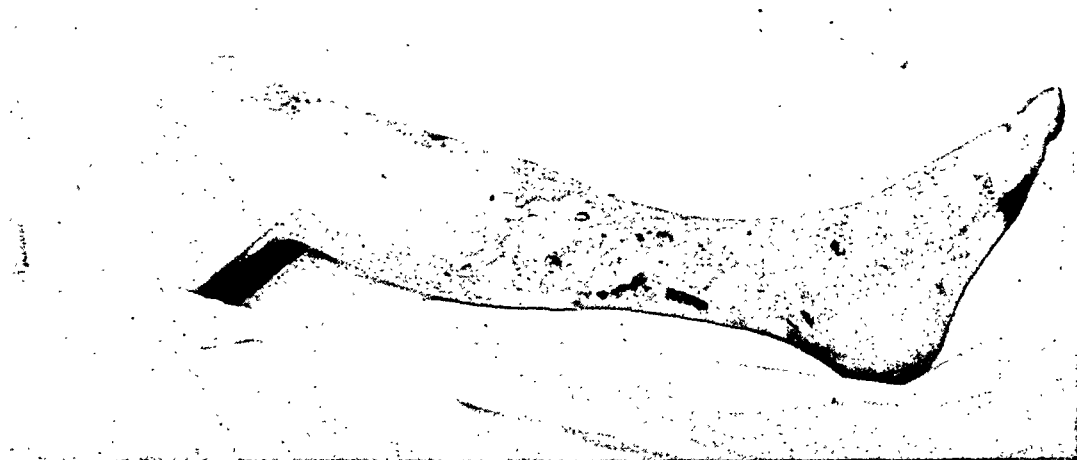


FIG. 1.—Case I. Showing contracture at the knee and the extent of the ulcerations.

the femoral on either side, the left heel had an ulceration and there was impending gangrene of two toes. On October 3, 1924, five centimetres of the adventitia of the left superficial femoral artery were removed. There was no improvement and amputation was done eighteen days later.

CASE IV.—Male, aged fifty-seven, a private patient, referred because of pain in the right foot and calf for seven weeks. He had moderate arteriosclerosis of all palpable vessels, but he had pulsation in the peripheral arteries of the foot. There was an early dry gangrene of two of the toes. On January 28, 1924, five centimetres of the adventitia of the right superficial femoral were removed. The artery appeared normal in size and contracted during the manipulations. Shining through the vessel wall, after the removal of the adventitia, could be seen many calcareous plaques. Following the operation there was relief of pain which has lasted one and a half years, except for occasional slight discomfort. Several of the toes were subsequently amputated because of the dry gangrene.

CASE V.—Male, aged sixty-five, admitted to the Montefiore Hospital because of pain in the right foot which had been present for six months. On examination no pulsation could be felt below the common femoral artery. On September 18, 1924, five centimetres of the adventitia were removed from the right superficial femoral. At the operation it was noted that the artery was adherent to the vein, that the adventitia was densely adherent and that no pulsation could be seen or felt in the artery. There was no relief following the operation.

CASE VI.—Male, thirty-one years old, was admitted to Mt. Sinai Hospital, because of pain in the left leg and foot for two years with ulceration of the big toe for several months. A pre-operative diagnosis of thromboangiitis was made. On May 13, 1924,

five centimetres of the left superficial femoral artery were denuded of adventitia. There was considerable periarteritis and the lumen of the vessel was entered, requiring a lateral ligature. The vessel did not contract after the stripping. There was no post-operative change in the appearance of the foot, but on his discharge fourteen days later he had less pain than on admission. However, the pain returned in seven weeks and he was readmitted, at which time a lumbar sympathectomy was performed by Dr. Harold Neuhoof. Following this operation there was a well-marked vasodilatation of the peripheral vessels with increase in warmth of the foot on the operated side and a temporary relief from pain. However, with a return of the pain an amputation was done three weeks later.

CASE VII.—Male, aged forty-four, who had an amputation of his right leg nine months previously, was admitted to the Montefiore Hospital for a painful ulcer in the middle third of the left leg. This ulceration had existed for two and a half years, during which time it had healed and broken down several times. The diagnosis was thromboangiitis. Under local applications the ulcer healed but broke down again after a few days. On January 26, 1924, the adventitia was removed from the left superficial femoral artery. There was post-operative warmth in the foot but no influence on the ulcer. Several months later this healed under local treatment and has remained healed to date. The operation can receive no credit for this result.

CASE III.—Male, aged thirty-nine, a mild diabetic in the wards of the Montefiore Hospital, was seen in consultation because of an ulceration in the middle third of the right leg. The lesion was five centimetres in diameter and very painful. Over a period of several months it resisted all attempts at healing it. Skin grafting was tried several times without avail; the patient was given anti-luetic treatment in spite of all negative tests. On September 6, 1923, a periarterial sympathectomy was done. The vessel appeared normal and contracted, there was post-operative warmth in the foot and for a time a diminution of the pain but no influence on the ulcer. Finally because of pain the leg was amputated at the request of the patient.

CASE IX.—A twenty-six-year-old man had sustained a fracture of the third and fourth lumbar vertebrae seven years prior to his admission to the Montefiore Hospital. At the time of this injury he had been operated upon at Bellevue Hospital by Dr. Harold Neuhoof with considerable improvement in his condition. He came to the Montefiore Hospital because of trophic ulcerations of the right heel and buttock. Hoping to benefit the lesion on the heel, on December 13, 1923, a periarterial sympathectomy was done on the right femoral artery. Immediately after the operation the dorsalis pedis and the posterior tibial arteries which had always been readily palpable could not be felt. This was followed by the usual dilatation and warmth. Comparative blood-pressure determinations showed that whereas prior to the operation the pressure was the same in the two legs, 128 systolic, for the first two post-operative days the pressure on the operated side was 134 to 136 as compared to 128 to 130 on the other side. Readings taken after this time failed to show any difference between the two legs. At first no change was noted in the ulcer of the heel, at the end of three weeks there was a questionable improvement, but a week later the ulcer was distinctly smaller and cleaner. However, it never completely healed and remains to date about the same as it was three weeks after the operation.

CASE X.—A man, sixty-four years old, had had the large toe of his left foot amputated because of gangrene in July, 1924. He was admitted to the Montefiore Hospital in November, 1924, because of severe pain in the left leg and foot and an unhealed area at the operated site. This latter healed but the pain persisted. On February 11, 1925, Dr. J. Gottesman did a periarterial sympathectomy on the left superficial femoral artery. At the operation it was noted that no pulsation could be seen or felt in the exposed vessel (none had been previously felt in the branches in the foot). There was no contraction of the vessel observed after the removal of the adventitia. To our surprise

after the operation there was relief of pain, which except for an occasional twinge has persisted.

CASE XI.—A woman of fifty-five came to the Montefiore Hospital in May, 1925, because of severe pain in the right leg and foot for fourteen weeks and a beginning moist gangrene of the toes for five days. Following a periarterial sympathectomy done on May 6, her pain was relieved for forty-eight hours, but with the progression of the gangrene it returned and her leg was amputated on May 12.

Of this total of eleven cases seven were of arteriosclerotic origin, two were thromboangiitic, one was a trophic ulcer, and one was an ulcer in a mild diabetic perhaps on a thromboangiitic basis. Three patients were completely relieved of pain, one of whom, however, lived too short a time to determine the permanency of the relief and one subsequently lost several toes in which dry gangrene existed at the time of the sympathectomy. One of the thromboangiitic cases was slightly but only temporarily improved. The trophic ulcer was somewhat benefited. In the remaining six cases no benefit could be seen from the operation. However, I have seen no instance where the operation did any harm.

From this small group of cases I have been unable to determine any method of selecting favorable cases. Success and failure were met in seemingly similar cases. In Case X, where the femoral artery seemed completely occluded at the time of operation, the pain was relieved, although this result was unexpected when the condition of the vessel was noted. One observation was made which may prove of value in the selection of cases when pain is the indication, that is the pre-operative use of an antispasmodic such as benzyl benzoate. Temporary relief was obtained by its use in Cases I, IV and XI (it was not tried in Case X), and in these patients relief of pain was obtained by the sympathectomy. In other cases the drug failed to relieve the pain and so did the operation. Further experience must be had to determine whether this is simply an impression or of actual value in the selection of cases.

It is possible that in some cases of vascular disease of the extremities in addition to the structural changes in the arteries, or perhaps dependent on them, there is a spasm of the finer radicles and capillaries. Where such is the case we may expect beneficial results from a removal of the adventitia. Lehrmann<sup>5</sup> and Låwen<sup>6</sup> believe that the operation of periarterial sympathectomy divides the sensory nerves to the vessel, and by so doing influences the vascular tonus by interruption of the reflex arc. This theory to me seems best to explain the results obtained in keeping with the anatomy and the physiology of the vaso-motor system. The operation would be comparable to the division of the posterior spinal nerve roots for spastic conditions of the skeletal muscles.

#### CONCLUSIONS

1. In periarterial sympathectomy we have an operation which in some cases causes definite changes in the peripheral circulation.
2. At the present time the explanation of its action is not clear, and the indications for its use are not sharply defined.

## PERIARTERIAL SYMPATHECTOMY

3. In my hands the best results have been obtained in patients with pain, due to arteriosclerotic disease of the vessels of the legs.

### REFERENCES

- <sup>1</sup> Leriche, R.: Lyons Chir., vol. x, p. 378, 1913.
- <sup>2</sup> Potts, L. W.: Distribution of Nerves to Arteries of the Leg. Anatom. Anzeiger, vol. xlvii, p. 138, 1914.
- <sup>3</sup> Kramer, J. G.: The Distribution of Nerves to the Arteries of the Arm. Anatom. Rec., vol. viii, p. 243, 1914.
- <sup>4</sup> Langley, J. N.: The Vascular Dilatation Caused by the Sympathetic and the Course of the Vaso-motor Nerves. J. of Physiol., vol. lviii, p. 70, Oct., 1923.
- <sup>5</sup> Lehrmann, W.: Zur Wirkungsweise der Periarteriellen Sympathektomie. Zent. f. Chir., vol. li, p. 839, 1924.
- <sup>6</sup> Lāwen, A.: Ueber Periarterielle Sympathektomie bei der Extremitätentuberkulose. Munch. Med. Woch., vol. lxxi, p. 191, Feb. 15, 1924.

# NEOPLASMS OF THE BLOOD-LYMPH-VASCULAR SYSTEM WITH SPECIAL REFERENCE TO ENDOTHELIOMAS \*

BY D. SCHUYLER PULFORD, JR., M.D.

OF ROCHESTER, MINN.

FELLOW IN PATHOLOGY, THE MAYO FOUNDATION

THE observation that tumors diagnosed hæmangiomas not infrequently recur after excision, and in some cases even metastasize until they kill the patient, together with the fact that benign hæmangiomas and so-called malignant endotheliomas often show morphologically indistinguishable areas, usually in the nature of partially differentiated blood-vessels, prompts the following generalizations.

1. Hæmangiomas and lymph-vascular angiomas, although usually benign, are potentially malignant endotheliomas.

2. There is an intermediate stage between the strictly benign and the actually malignant angiomas, represented by hæmangio-endotheliomas.

3. Malignant endotheliomas of the blood-lymph-vascular system exist as a pathologic entity.

My object in this paper is to present the data in support of these generalizations.

Endotheliomas will naturally demand considerable attention in the consideration of a group of tumors arising from an organ in which endothelium plays such a large part, as in the lining of the channels and spaces of the vascular and lymphatic systems. That such tumors arise from the blood-lymph-vascular system is in many instances evident from their study under the low power lens of the microscope, since certain areas are composed of tumor blood-vessels and vessels lined with endothelium.

I shall endeavor to show that there is a solid type of tumor in this group, relatively malignant, which can be seen to develop from, and to be composed of, blood-vascular tissue, which differentiates into endothelial lined channels and blood-vessels, indicating that the function of the adult cells is to line blood channels and lymph channels, and thereby show that the type cell is endothelium and the tumor is endothelioma.

*Embryology.*—It formerly was taught that endothelium was mesodermal in origin. However, it must be borne in mind that the mesoderm has its anlage in the primitive embryonic ectoderm during the early stages of development, extending laterally from the primitive streak and groove between ectoderm and endoderm. It is therefore logical to suppose that when endothelial tissue becomes malignant, it may in its reversion to embryonic type show morphologic characteristics of both epithelial tissue (carcinoma) and meso-

---

\* Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Pathology, April, 1925.

Submitted for publication July 22, 1925.

## NEOPLASMS OF THE BLOOD-LYMPH-VASCULAR SYSTEM

dermal tissue (sarcoma). This possible bimorphism of endothelial cells might account for some confusion concerning malignant tumors of the pleura and pericardium. Reports of primary endothelioma and carcinoma of the pleura are common. Robertson,<sup>33</sup> in a recent review of the literature, while reporting four tumors of the pleura and one of the pericardium, has done much to clarify this subject, and in fact shows that endotheliomas or carcinomas of the pleura or pericardium are not primary. He demonstrates that such tumors are secondary carcinomas, usually from the lung, and that if a tumor is primary in the pleura, it must be sarcomatous. The term true endothelium is applied to that derived from the solid mesenchymal part of the mesoblast, in contra-distinction to the celomic or body cavity derivative of the mesoblast which gives rise to the endothelium of the pleura, pericardium, and peritoneum, and is really a mesothelium. The so-called endothelium of the cerebrospinal meninges will not be considered. Mallory<sup>25</sup> points out that it is not genetically identical with the endothelium, lining vascular and lymphatic channels, since it forms at a later period in embryonic development from the notochord.

It seems reasonable to believe that endothelium has in its very earliest development a contribution from both ectoderm and mesoderm, and there are but two important theories of origin of blood-lymph-vascular endothelium, the angioblast theory of His, and the theory of local origin. In the theory of His it is asserted that the so-called angioblast appearing early on the yolk sac gives rise to the endothelium of its blood-vessels which by their proliferation and down-growth invade and form the intra-embryonic vascular systems, also that all intra-embryonic endothelium of whatever nature arises from this preëxisting angioblastic endothelium of the yolk sac, or that there is never a local origin from mesenchymal tissue. In the theory of local origin, described by Reagan,<sup>30</sup> it is asserted that mesenchyme may, in practically any part of the body, change into blood-lymph-vascular tissue, and is not necessarily in direct descent from the yolk-sac endothelium of the angioblast. The theory further presumes that mesenchymal cells can by migration and alignment form vascular channels or cavities lined by endothelium, and that there are various embryonic regions where there is a first-hand production of vascular tissue, even to blood-cells themselves.

The "theory of local origin" is probably the most favored explanation of the origin of the vascular and lymphatic systems among competent anatomists and embryologists to-day. Sabin<sup>35</sup> supported the angioblastic theory of intra-embryonic lymphatic development. By injecting India ink into subcutaneous tissues of pig embryos, she showed to the satisfaction of many that all lymph-vessels budded off from the veins at four primary centres, and then invaded the skin, as well as the deeper tissues, by a process of centrifugal growth. Clark, Evans, and Minot also supported this view, and in fact, by 1912, this theory seemed generally accepted.

The theory of the development of endothelium *in loco* from mesenchyme dates from the work of Reichert, Goette, Felix, and more recently Rùchert



and Mollier, Maximow, Bonnet, and other European anatomists. Huntington and McClure until recently were its only sponsors in this country. Their series of convincing articles is summed up in Huntington's monograph which appeared in May, 1911. In 1912, Kampmeier demonstrated independent lymphatic endothelium anlagen in the thoracic duct of an injected pig embryo. Emmel, Reagan and Stockard stand as proponents of the theory of the local origin of endothelium. Soon even Sabin was led to accept in part the local origin theory by her studies of intra-embryonic blood-vessels and the formation of red blood-cells in living embryo chicks.

From now on the pendulum swings toward the theory of local origin, and McClure gives the present predominant opinion in the following words:

"While differences of opinion may still exist, as regards details of the process, both for the lymphatic and blood vascular systems, it is plain from this brief sketch that the general principle of the local genesis of intra-embryonic endothelium from mesenchyme, a theory so recently and so vigorously opposed by a large group of American anatomists, may now be regarded as an established fact." This statement has an important bearing on tumors of endothelium.

*Problems of Classification.*—Most tumors of blood-vessels and lymph-spaces have been easily recognized and correctly described and diagnosed as capillary or cavernous lymph-angiomas and hæmangiomas. When the cellular activity of these tumors becomes such that open spaces give place to solid masses and the compact areas are composed of endothelium-like tissue rather than fibrous tissue or epithelial cells, the classification and correct diagnosis become controversial. Invasion of adjacent tissues, local post-operative recurrence and metastasis further complicate the picture.

MacCallum says, "In practically no case has the origin of a tumor from endothelium been proved." But theoretically tumors of endothelium can occur in any part of the body, since that kind of tissue exists in or about all organs.

Most pathologists classify malignant tumors from the standpoint of the predominating cell, considering not only its structure, but also its embryonic origin, for when very malignant it loses all likeness to its adult functioning form.

Mallory<sup>20</sup> says, "The type cell is the one important element in every tumor." He goes on to show that histologic classification of slow-growing tumors is satisfactory, for they differentiate well, while with fast-growing ones embryology helps in recognizing types of cells and in explaining unusual situations of tumors. Ewing summarizes the problems of the classification of tumors as follows: "The generally accepted plan of classification and terminology which is based on histology, modified as much as possible by histogenesis, is a natural product which has become very firmly established and probably deserves to prevail against the varying prominence of embryology, chemistry, and etiology." A purely embryologic classification is not sufficient, as the origin of some parts of the body is not well understood. For instance, the Wolffian body may not be really mesoblastic; and again the adenomas,

and even so-called carcinoma of the kidney, instead of being classified as mesotheliomas, as they should if these organs are derived from mesothelium, are called epitheliomas. A strictly embryologic classification falls short in tumors such as malignant endotheliomas, which at times cannot be distinguished from carcinomas, or indeed, sarcomas by their histopathologic structure. Structure alone is insufficient as a criterion for classification of many tumors, for, as previously stated, highly malignant tumors, even from most dissimilar tissues, are indistinguishable.

A third great help in the classification of neoplasms, seldom mentioned in the past, is the knowledge and study of "reserve cells." The embryologic conception of three germ layers, as applied to tumors, while convenient in classifying neoplasms, is no longer necessary, and is in fact a mental hazard which keeps the more enlightened present-day conception of tumors from being accepted in practice. As MacCarty has shown in cancer of the breast that the *membrana propria* or "reserve cell" is the key to early carcinoma, so an attempt must be made to discover the embryologic "reserve cell" in studying tumors supposed to have arisen from vascular or lymphatic channels.

*Endothelium.*—Endothelium is spoken of as a primitive tissue, growing by "sprouting" as well as by mitotic division.<sup>5</sup> It is known that it comes from preëxisting endothelium. McClure<sup>23</sup> and others have demonstrated the mesenchyme cell to be the reserve cell of endothelium in the embryo.

It is usually stated that the specialization concomitant to the demand for function in adult organisms destroys the power of regeneration directly in proportion to the degree of specialization. In the adult, reproduction in such a tissue as endothelium is supposedly by direct division or sprouting, and occasionally by mitotic division, mesenchyme cells no longer being visible. This failure to find a "reserve cell" for endothelium in the adult has its exceptions. MacCallum describes connective tissue that has assumed the structure and function of endothelium in the repair of an infected wound of the neck of the adult dog. He explains this as a "kind of metaplasia, analogous to that which occurs in the first formation of endothelium." I have seen this same process in tumors of endothelial-lined spaces with adjacent areas showing solid masses of cells morphologically indistinguishable from endothelial cells. Considering these different cells as derived from mesenchyme, it is no wonder that they sometimes show in the adult a multiplicity of form, approaching in appearance, fibroblasts or fibrocytes here, epithelioblasts there, and again endotheliocytes in other places. This may be a manifestation of metaplasia, but might better be called an example of atavism since it is an inheritance from remote rather than immediate ancestors, from mesenchyme rather than fibroblasts.

If there is sufficient injury to destroy adult tissue of so-called mesoblastic origin, the mesenchymal primitive connective tissue responds to the demand for repair. This cell usually looks like a fibroblast, but may, and in fact ought, at times to resemble, in different environments and in different stages

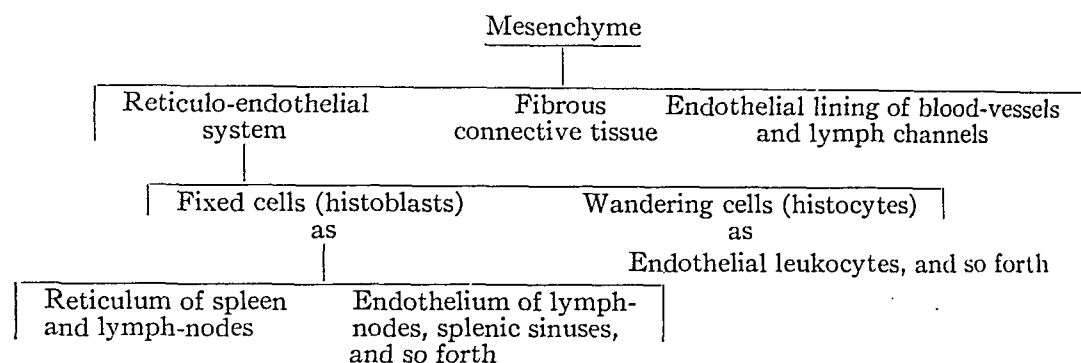
of repair, other different types of specific cells or tissues that arise from it, such as the following:

1. All the cells of the reticulo-endothelial system such as the reticular cells of splenic stroma and lymphatic tissue as well as the endothelial cells of the liver, lymph-gland and spleen sinuses, adrenal and hypophyseal capillaries (histoblast), fixed tissue cells, and the histocytes and wandering tissue cells such as the endothelial leukocyte series of cells.<sup>1</sup>

2. The connective-tissue series of cells which in adult form are called fibrocytes.

3. The endothelial cells lining blood-vessels and lymph-channels.

#### CELLS DERIVED FROM MESENCHYME



It is evident, therefore, that a certain polymorphism will be seen in tumor cells derived from the endothelial lining cells of the blood-lymph-vascular system, one of these so closely allied series of cells, so alike in function and origin. These tumors are therefore divided into three distinct groups, considering all endothelium-lined vessels as one, whether they contain blood or lymph: (1) angiomas, (2) angio-endotheliomas, and (3) endotheliomas.

The name endothelioma does not indicate its derivation from blood-channels or lymph-channels. The reasons for including it are brought out in the discussion. Suffice it to say that certain areas in the angio-endotheliomas, taken apart from the definitely vascular areas, simulate exactly morphologically the small group of tumors (Group 3), previously called endotheliomas, and seems to place the origin of the latter also in the lymph-blood channels.

*Material Studied.*—This report, while primarily a histopathologic study, includes a review of the clinical findings and end results of 290 cases of neoplasms at the Mayo Clinic, which were reported to have arisen in the blood-lymph-vascular system during the sixteen years from 1907 to 1922, inclusive. The material is only from the surgical pathologic laboratory and includes specimens removed at operation, but none of the many angiomas found in the internal organs at necropsy. The tissue was studied independently of all diagnoses, reports, or other data. Of the 290 cases on file ninety were discarded for various reasons; many specimens were lost; there was not sufficient material for proper study in other cases, and in some of the earlier ones the diagnoses were incorrect, especially in the endothelioma group.

# NEOPLASMS OF THE BLOOD-LYMPH-VASCULAR SYSTEM

The following tumors have been called endotheliomas in the past: mixed tumor of the parotid gland and palate, squamous-cell epithelioma, melanotic epithelioma, adamantinoma of the jaw, carcinoma of the appendix, metastatic epithelioma of the chest, neuroma, and benign xanthic tumor of the tendon sheath. Two very interesting tumors of the upper extremity with skin involvement were discarded, as they were probably Ewing's primary endotheliomas of bone. Another tumor, while resembling endothelioma, was thought at necropsy to be possibly of primary osteogenic origin, and was discarded. Follow-up letters were sent to all living patients not heard from within a year.

Tumors arising in celomic endothelium, such as those in the peritoneal cavity, pleura and pericardium, are not considered in this study, nor the so-called endotheliomas of the cerebrospinal meninges. Several tumors of the orbit were ruled out as probably of this origin.

On microscopic examination, the different specimens, with the exception of one type, arrange themselves into certain groups which conform very well to the classification already offered for such tumors. The one exceptional type of neoplasm is what has been variously named endothelioma, angiosarcoma, perithelioma, cylindroma, and so forth, fibrosarcoma, mixed-cell sarcoma, or not infrequently, carcinoma.

The neoplasms studied comprise three large groups: (1) angiomas, (2) angio-endotheliomas, and (3) endotheliomas. The term angioma is used to include tumors of both blood-vessels and lymph-vessels. For convenience of arrangement they are divided into ten main groups, according to their anatomic location (Table I).

TABLE I

*Two Hundred Cases of Neoplasms of the Blood-lymph-vascular System, Showing Frequency of Occurrence of the Angioma, Angio-endothelioma and Endothelioma.*

Location	Cases	Per cent. of total	Angioma		Angio-endothelioma		Endothelioma	
			Cases	Per cent.	Cases	Per cent.	Cases	Per cent.
Breast.....	7	3.5	6	85.7	1	14.3		
Extremities (upper)...	28	14.0	22	78.5	5	17.9	1	3.6
Extremities (lower)...	28	14.0	25	89.2	1	3.6	2	7.2
Gastro-intestinal tract	7	3.5	7	100.0				
Genito-urinary tract..	20	10.0	19	94.7			1	5.3
Head and face.....	36	18.0	33	91.7			3	8.3
Lip.....	34	17.0	34	100.0				
Neck.....	11	5.5	11	100.0				
Tongue.....	16	8.0	16	100.0				
Trunk.....	13	6.5	10	76.9	2	15.4	1	7.7
Total.....	200	100.0	183	91.5	9	4.5	8	4.0

## DESCRIPTION, TREATMENT AND RESULTS

*Angiomas.*—Angiomas are obviously benign, circumscribed tumors, often noticed at birth, occurring almost anywhere on the surface of the body, and occasionally in the internal organs. They cause great trouble only when congenital or in children of tender years, or when very extensive and so

## INFANTILE PYLORIC STENOSIS

Sedgwick<sup>29</sup> fed breast milk to 44 infants and lost but one. Heubner<sup>30</sup> applied the same treatment to 21 infants with a mortality of 22.9 per cent. Ibrahim<sup>31</sup> collected from the German literature reports of eighty-three patients treated medically with a mortality of 22.9 per cent. Thomson cured twenty-six of his fifty-four patients and Parsons and Barling<sup>32</sup> cured five of their thirty-six patients.

Regarding the method, Thomson states that we cannot expect by medical treatment to greatly hasten the opening of the passage. We may be able to relieve it, however, just sufficiently to keep the child alive in spite of the continuation of the obstruction until spontaneous recovery has had time to occur.

Still maintains that the influence of spasm is indicated by the fact that food occasionally passes. According to Richter, however, the tumor mass mechanically blocks the lumen, but it is tunnelled by an intact mucosa, the closure of which is exactly analogous to the blocking of the urethra by a large prostate. As increasing tension in the urinary bladder may produce an overflow incontinence, so stomach contents may be forced through. He stigmatizes medical treatment as a laborious attempt to coax an already dilating stomach to undergo an hypertrophy sufficient to overcome the pyloric stenosis. And Faber<sup>34</sup> reiterates that congenital stenosis, if not relieved in time, inevitably leads to enlargement of the stomach, the effects of which may be felt all through life.

Thomson, on the other hand, found that none of the thirty-three patients followed up after medical treatment showed any signs of serious gastric derangement. The ages of these children at the time of the investigation varied from ten months to sixteen years and nine months. Recovery was apparently complete. Holt agrees that patients treated medically usually show no symptoms after the first year, but adds that possibly the hypertrophy may be the basis of pyloric obstruction in later life.

Veeder, Clopton and Mills<sup>35</sup> studied eight children röntgenologically. Four had been subjected to operation and four had been treated medically. In the group were sister and brother. The sister had been a strong and healthy child and a very difficult first year. She had never been a strong and healthy child and has about the same physical development as her brother two years younger, who had had a Rammstedt operation. The little girl evidently was a victim of no abnormality in either child. The investigators have heard of no similar instance. Analysis of the medical treatment of infantile pyloric stenosis reveals that in one series in which all the patients recovered, several of the cases lacked some of the characteristic symptoms.

Bolling avers that no medical treatment that involves taking a breast-fed baby off the breast is admissible. Still believes that the possibility of retaining the breast feedings should decide in favor of immediate operation rather than risk the loss of the mother's milk through her prolonged anxiety

NEOPLASMS OF THE BLOOD-LYMPH-VASCULAR SYSTEM

TABLE II  
Detailed Clinical Data of the Angiomas

Situation	Patients							Tumors							Treatment				Result of treatment		Associated lesions			
	Cases	Per cent of total	Average age of patients years	Age of youngest patient years	Age of oldest patient years	Males	Females	Family history of malignancy or birth-mark	Injury	Congenital cases	Average pre-operative duration years	Average size, cm	Largest size, cm	Smallest size cm	Multiple	With associated neo-plasm	Previous	Excision	Excision and radium	Radium		Recurrent	Patients not cured	
Breast	6	3.3	45.5	27.00	45.5		6	1	1		9.0	1.0	1.2	0.30	6	1	2	6	2					Basal-cell epithelioma of chin
Extremities (lower)	25	13.7	38.8	58	60.0	6	19	1	1	9	11.1	3.3	7.0	2.00	1	4	2	23	2		4	*3	Three goitres, one adenofibroma of breast *One toe amputated without cure	
Extremities (upper)	22	12.0	30.6	20	66.0	4	18	1	3	6	12.4	2.6	18.0	0.50	4	2	8	*18	3	1	4	1	One squamous-cell epithelioma of forearm, one lipoma *One amputation necessary	
Gastro-intestinal tract	7	3.8	44.6	22.00	67.0	2	5	1			3.0	7.1	15.0	2.00	2	2		7					One squamous-cell epithelioma of lip, one pelvic tumor	
Genito-urinary tract	19	10.4	41.2	19.00	76.0	5	14	2	1		3.8	4.0	10.0	0.50		3		*18		1	3		One uterine fibromyoma, two goitres *Two excision and fulguration	
Head and face	33	18.0	30.3	27	60.0	22	11	5	6	6	5.0	3.3	10.0	0.50	3	4	9	25	7	1	1	1	One goitre, one basal-cell epithelioma of cheek, one melano-epithelioma of ankle, one squamous-cell epithelioma of jaw	
Lip	34	18.6	38.1	65	71.0	18	16	5	3	3	5.7	1.4	3.0	0.50	1	5	10	31	3		3		Two goitres, one lipoma, one squamous-cell epithelioma of lip, one leukoplakia of mouth	
Neck	11	6.0	22.2	25	65.0	4	7			5	9.6	5.5	10.0	1.0	1		2	9	2		4		One squamous-cell epithelioma of lip	
Tongue	16	8.7	36.0	25	66.0	9	7	2	1	3	3.7	1.6	3.0	1.0		1	3	13	3		5		One uterine fibromyoma	
Trunk	10	5.5	34.3	14	76.0	5	5		1	2	7.3	3.6	15.0	1.0		1		10		3	24	5		
Total	183					75	108	18	17	34	7.06	3.34	9.22	93	18	23	34	160	20	3	13.1 per cent			

an angioma of the stomach, 15 cm long, while the smallest was 3 mm in diameter. Twelve cases were multiple. Thirty-four patients came with a history of previous treatment. The records show that the treatment of choice at the Mayo Clinic was knife excision, which was employed in 160 of the 183 cases. This was followed by applications of radium if the site and extent of the lesion did not permit complete excision. Radium was used alone in only three cases.

*Angio-endotheliomas*—Angio-endotheliomas comprise a relatively small percentage of the total cases, but are the most important ones for study, as they appear to be a connecting link between the benign angioma and the malignant endothelioma. There were nine cases: six in the extremities, two in the trunk, and one in the breast.

Angio-endotheliomas do not differ grossly from angiomas, save that they are more irregular in outline and appear, as a rule, more solid in certain areas, and more meaty on section. The microscopic picture differs from that of the more circumscribed benign angiomas in two main respects. The first and most important difference is the presence of an occasional mitotic figure. The change from the benign to the malignant state is best indicated by this landmark. The malignant endotheliomas contain numerous mitotic figures. The second difference is that the cavernous or fibrous areas, characteristic of the angioma, give way in small areas to solid masses of larger, less differentiated cells whose structure, studied under the higher-powered lenses of the microscope, is seen to approach that of endothelial cells. These cells, however, continue to grow into numerous vessel-like channels in most areas, still suggesting that a capillary type of angioma is present. The reaction in surrounding tissue is somewhat different, but the diagnosis should be based entirely on cytologic study. The differentiation into vessels, which in this case are tumor vessels, is analogous to the formation of keratin pearls in a relatively benign, although definitely malignant, squamous-cell epithelioma.

The repeated recurrence of angio-endotheliomas after apparently adequate excision prompted more careful study of them, until now a definite group can be recognized. These tumors are considered cytologically the forerunners of a definitely malignant tumor of endothelium. In order to indicate their pre-malignant or early transition stage, I have called them angio-endotheliomas. They are relatively benign, malignant tumors, their growth being checked by their differentiating into blood-vessels.

Five of the nine angio-endotheliomas appeared on the upper extremities. There was recurrence in four cases, metastasis in one, and two patients died, one of whom was a child of eleven with extensive involvement of the jaw and mouth.

On account of the small number in the series, and the similarity in the numbers of angio-endotheliomas and endotheliomas, groups 2 and 3 will be discussed together and analyzed in one table (Table III).

*Endotheliomas*—The endotheliomas comprise a rare group of tumors lying morphologically midway between carcinomas and sarcomas, but are as

NEOPLASMS OF THE BLOOD-LYMPH-VASCULAR SYSTEM

Detailed Clinical Data of Angio-endotheliomas and endotheliomas	
Patients	Tumor
years	
rs	

[illegible]



a rule relatively benign, as judged by their long duration and the tardiness and infrequency of metastasis

There were eight cases of endothelioma, distributed as follows: extremities, three, head, three, and trunk and genito-urinary tract one each. There was recurrence in six, metastasis in one, and death in one.

The gross appearance of endothelioma arising in the blood-lymph-vascular system in this series was quite similar to that of fibrosarcoma. Hemorrhagic and cystic areas are as a rule strangely lacking and it is thought probable

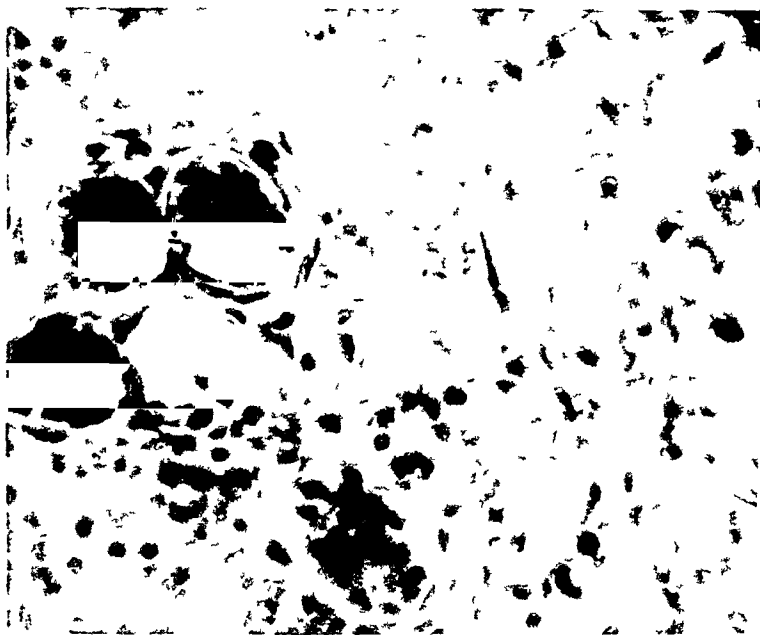


FIG. 1—Malignant angioendothelioma of breast showing red blood cells in the angiomatous spaces in the immediate vicinity of the most malignant part of the tumor. An example of differentiation into blood-vessels ( $\times 500$ )

that this is one of the chief reasons why their origin from blood-lymph-vascular endothelium has been overlooked. The cut surface looks grayish in the fresh specimen but is quite white and fibrous-appearing when it is fixed in formalin. It is fairly homogeneous, as a rule, without irregular lobulated areas although fibrous tissue strands are seen.

The microscopic section shows that the tumor is quite cellular with numerous mitotic figures and frequent invasion of fat and muscle. Morphologically the cell resembles endothelium, although it is more spheroidal in shape and larger, and the nuclei show hyperchromatosis. Differentiation into tumor blood-vessels is seen in some instances. There may be fairly large areas of fibrotic tissue and lymphocytic infiltration, and even hyalin formation. In some areas the similarity to the histologic picture of a certain stage of Hodgkin's disease is striking. The numerous mitotic figures in masses of rather undifferentiated cells signify malignancy, and the differentiation of certain of the tumor cells into blood-vessels indicates its endothelial type.

Angio-endothelioma and endothelioma are less common than angioma. The average age incidence is earlier, much earlier if the birth naevus is omitted; the predominant sex is female, the average pre-operative duration is shorter, treatment is less successful and recurrence more common (ten out of seventeen compared to twenty-four out of 183 cases). Metastasis and death, while not encountered in cases of angioma, followed both angio-endothelioma and endothelioma.

Very little difference is found between angio-endothelioma and endothelioma. It is important that the former be recognized as more than a simple angioma, so that it may be eradicated before it advances in malignancy and becomes an endothelioma. Important distinguishing clinical features are lacking and differential diagnosis is impossible, so that the burden of diagnosis is placed on the pathologist. His information, while of scientific importance in emphasizing the morphologic and cytologic truths shown by the tissue, should not influence the treatment of the two groups of tumor, for each should have early wide surgical excision followed by prolonged radium treatment and frequent observation to prevent local recurrence, if possible. If such occurs, immediate further excision is required. Metastasis is rare from these tumors and occurs late.

CASE REPORT I—A woman, aged thirty-eight years, came to the Clinic May 29, 1921, complaining of tumor of the left breast slowly recurrent in the scar resulting from the simple amputation in 1917 for a "fibro-epithelial" tumor. The family and personal histories gave negative information, and there was no record of tuberculosis or malignant disease in the family.

She was a healthy looking, vigorous young woman with a good color. Nothing abnormal was found except an irregular, soft mass in the scar of the operation on the breast, with several bluish-red areas in the surrounding skin, and fibromyoma of the uterus. The Wassermann reaction was negative, the hæmoglobin was 70 per cent (Dare), the erythrocytes numbered 4,080,000, and leucocytes 6100. The differential count and platelet count were within the normal bounds, and bleeding time was three minutes. A roentgenogram of the chest was negative.

The patient submitted to nine operations for recurrent tumors from April, 1921, to December 12, 1923, death occurring April 21, 1924, from general asthenia and absorption from growths. April 1, 1921, the tumor in the scar of the old incision was excised. The pathologic report was hæmangioma. Six months later the patient noted a recurrent local tumor, 7 by 7 cm., a lump in the right breast about 10 cm. in diameter and a small bluish tumor in the left deltoid region. A bluish nodule was found in the cervix uteri. August 16, 1922, the right breast was amputated and the glands excised. The pathologic report was hæmangio-endothelioma of the breast on an angioma, glands inflammatory. Radium was applied to the recurrent tumors in the left chest, the arm and the cervix. April 2, 1923, the tumors in the left breast and left arm were excised. The pathologic report was hæmangio-endothelioma. July 11, the patient's general health was good in spite of the recurrence, more radium was applied. October 9, multiple nodules on the left chest and left arm and one on the left back just above the iliac crest were excised. The pathologic report was again hæmangio-endothelioma (Figs 1-6). December 12 nodules in the left chest arm back and shoulder (twenty or more) were cauterized between the scars of the previous operations. April 21, 1924, the patient died from asthenia and "absorption."

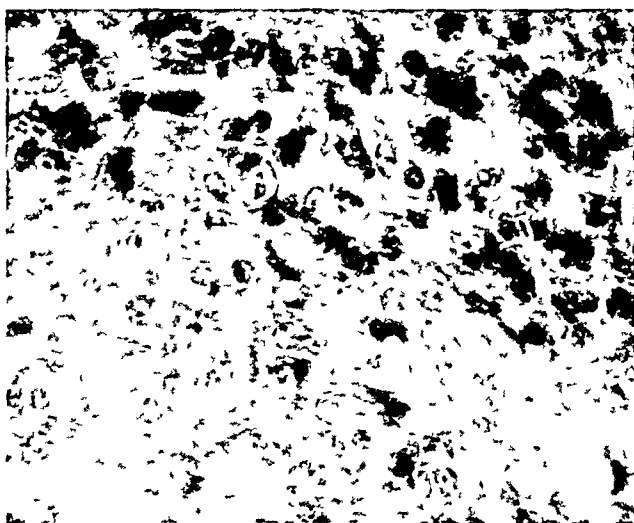


FIG. 2—Same as Fig. 1 showing rapidly multiplying round and oval malignant cells with multiple examples of mitotic figures (X 450).

*Comment*—This case illustrates how a benign hæmangioma may become a locally malignant hæmangio-endothelioma, and eventually show the characteristics of malignant endothelioma, ending in metastasis and death

*Discussion*—Wagner,<sup>5</sup> in 1874, described a malignant tumor of the endothelium occurring in the pleura. His description of the tumor cells, apparently primary in the lymph channels led subsequent observers to record similar cases as primary tumors of the pleura and Eppinger called such a tumor "endothelioma." Since then various writers have reported and

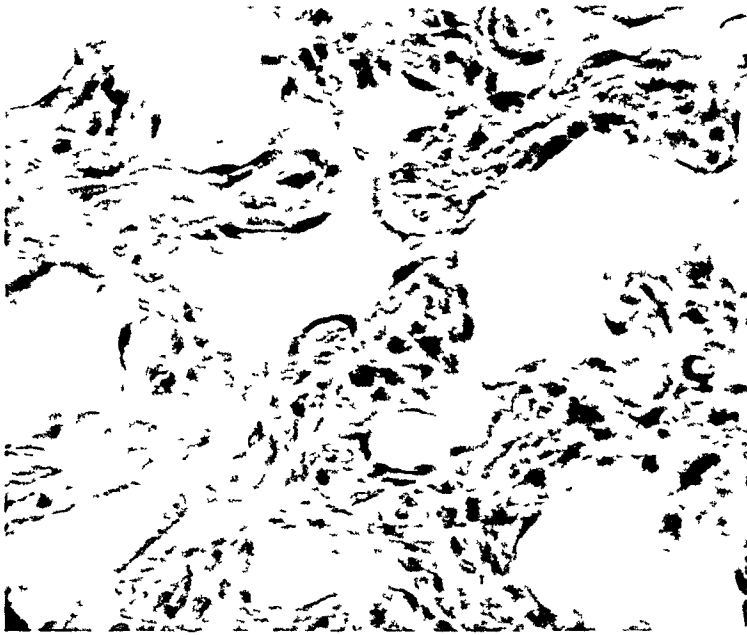


FIG 3—Differentiation into endothelium-lined channels and spaces  
( $\times 500$ )

described tumors as of endothelial origin but attention seems to have been focussed on the endothelium of serous membranes and bone to the exclusion of the endothelium of the blood-lymph-vascular channels. Dermatologists have from time to time reported tumors involving the skin whose cellular elements present the histologic characteristics of endothelial

cells.<sup>4</sup> Kaufmann as late as 1922, stated that endotheliomas belong histogenetically to the connective-tissue tumors. If my conception of the origin of endothelium is correct, endothelium does belong histogenetically, to connective tissue. In the case of tumors of the blood-lymph-vascular channels it can apparently be recognized as a special form of connective tissue, and therefore the tumors are classified as endotheliomas. Ewing's well-known primary single or multiple endotheliomas of bone seemed to be established without cavil.

It seems that there has been gradually increasing opposition to the conception of endothelioma as a distinct type of neoplasm. While fair so far as the serous membranes (celomic endothelium) are concerned, it would not seem justified by the study of the present series of tumors.

Since cells on becoming malignant lose or fail to acquire the characteristics by which they are known and classified in their completely differentiated state, it is necessary to investigate carefully the origin of the tissue under discussion, if it is not to be confused with other tissue or tumors when it becomes malignant.

Some malignant neoplasms are known to develop from a benign growth. A pigmented mole may become a melanotic epithelioma. Cancer of the

## NEOPLASMS OF THE BLOOD-LYMPH-VASCULAR SYSTEM

stomach is supposed to develop from simple gastric ulcer.<sup>40</sup> Leukoplakia sometimes becomes squamous-cell epithelioma.<sup>41</sup> Fibromas of the nasopharynx and other tissues show increasing degrees of malignancy, hastened and accelerated by repeated operations. A true conception of advanced growths is often best reached by a careful investigation and study of the earlier stages of their development.

In reviewing the development of a modern conception of growth and repair of tissues and a cytologic interpretation of tumor formation and malignancy, the contributions of Cohnheim, Hansemann, MacCarty and Biorders should be considered and contrasted. In 1877, Cohnheim suggested in a lecture to a group of students that his "test" theory of the formation of *monstra per excessum* superfluous fingers, giant extremities, and so forth, by embryonic cell in-



FIG 4 —Angio endothelioma showing endothelium-lined channels, malignant as indicated by mitosis (X 1000)

clusion, might also apply in the great and wider field of true neoplasms. This hypothesis has been for almost half a century accepted as a fact, although never proved. Many pathologists to-day, however, believe that just as a fertilized ovum is totipotent as regards the cells and tissues of the adult organism which develops from it, so certain early segmentation cells are multipotent, and each cell then is the possessor of inherent potentialities for development into various forms, tissues or organs. This property of the cell would explain the *monstra per excessum* teratoma, mixed tumors, and so forth.

MacCarty<sup>22</sup> says the three fundamental biologic reactions in cases of neoplasia are hypertrophy, hyperplasia and migration of the reserve cell on destruction of its overlying adult cell. He has called these reactions primary, secondary and tertiary cytoplasia. This work shows how nature has provided "reserve cells" in the mammary acinus to replace the destroyed adult cells. I believe endothelium has a reserve cell also. In the embryo it is clearly mesenchyme. In the adult it has not been identified. The terms, primary, secondary, and tertiary cytoplasia, do not represent degrees of malignancy, although they do express the biologic reactions which occur in the histogenesis or development of a malignant tumor.

Hansemann<sup>14</sup> wrote a great deal about the morphologic variation of tumors, but described them in terms of anaplasia and de-differentiation, and not in degrees of malignancy. He was intensely interested in the fact that malignant tumors, such as a carcinoma of the thyroid or of the liver, could, after metastasis to the brain or elsewhere differentiate enough to perform their adult function as seen by the production of colloid and bile.<sup>15</sup> He quotes a report by von Eiselsberg who removed a carcinoma of the thyroid with resulting myxedema. When later a metastatic tumor developed to a certain size the myxedema was relieved only to return on excision of the

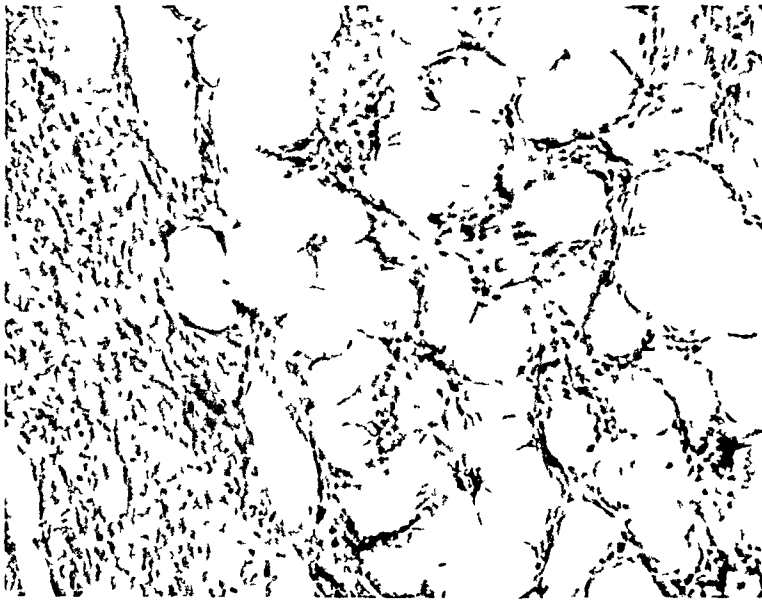


FIG. 5—Angio endothelioma showing invasion of fat by malignant process (X 120)

tumor. It remained, however, for Broders in 1919 to apply this principle of cyto-differentiation, as he saw it in various types and parts of malignant neoplasms, to the grading of malignancy. It is mentioned here as he shows in another tissue protective epithelium, how the reserve cell is the key to the situation.

On the principle of differentiation by which he grades squamous-cell epitheliomas it would seem possible to grade endotheliomas by an estimation of the amount of tumor blood-vessel formed. This has not proved of practical clinical value in this series of tumors possibly because the malignant tumors appeared to be of a uniform degree of malignancy. Theoretically and from the standpoint of cytology, however, it is possible to divide the malignant members of this group into grades according to the amount of differentiation into blood-vessels and connective tissue, frequency of mitosis, and the general tissue reaction. With the establishment of such a tumor as a malignant neoplasm of endothelium the next step should be to determine toward what type of cell they differentiate their degrees of differentiation, and then possibly the grade of malignancy.

The stratum germinativum of the skin as a forerunner of squamous epithelium and the fibroblast as the immediate progenitor of fibrous connective-tissue cells are good examples of reserve cells. Likewise, in the breast, when the secreting acinar cells are destroyed they are replaced by cells from the so-called basement membrane. Reserve cells of breast acini are not seen in non-lactating, normal adult breasts.

## NEOPLASMS OF THE BLOOD-LYMPH-VASCULAR SYSTEM

The endothelial cell is very primitive and the usual reaction to injury is seen in replacement by direct division of preexisting endothelial cells. The endothelial cell is more widely distributed throughout the body than almost any other kind, except perhaps the fibrous connective-tissue cell. It is possible then that the reserve cell of endothelium is identical with that of fibrous connective tissue, namely, the fibroblast, or that the primitive mesenchymal cell seen in the embryo as the forerunner of both is the reserve cell of endothelium, and that the mesenchymal cell lies invisible throughout the supporting structures of the body, ready to spring up into a malignant growth on adequate provocation, if the host has the proper hereditary tendency to tumor.

If, in the case of the definitely malignant solid tumors of this series, arising from vascular tissue the cells are too undifferentiated to be called endothelial cells, it is fair to suppose that they are genetically related cells, are surely not epithelial cells, often simulate fibroblasts, and because of their relation to vascular channels are most likely endothelioblasts. Almost invariably in some part of the neoplasm, perhaps in some cases so early in its development that it is not seen, there is definitely differentiated blood-vascular tissue.



FIG. 6—Angio-endothelioma superimposed on an angioma of the breast showing the highly malignant character of the growth. Large round and oval cells with irregular mitotic figure. ( $\times 1500$ )

### SUMMARY

A histologic study of the neoplasms of the blood-lymph-vascular system of 290 patients treated at the Mayo Clinic in the sixteen years from 1907 to 1922, inclusive shows 183 angiomas, nine angio-endotheliomas, and eight endotheliomas. Two hundred of the best preserved specimens, with full data and follow-up records, were selected for report. This simple classification seems adequate to meet all the clinical facts of the cases as well as all the known data from the standpoint of embryology, morphology, situation, and "reserve cell" diagnosis.

Endothelium in the embryo is derived from mesenchyme. In adult tissues, although not yet identified, the same mesenchymal cell lying invisible seems most likely to be the reserve cell of endothelium. Endothelium is closely linked with fibrous connective tissue in that mesenchyme is their common ancestor. This relationship does not preclude the existence of a specific tumor of endothelium, distinct from a fibrosarcoma.

The study of angiomas led to the recognition of the origin of the malignant tumors of this series from vascular endothelium. A case reported shows the change from benign to malignant in different stages. Specimens were

removed at operation during a period of three years, death finally occurring from metastasis and absorption from the growths

The original hypotheses seem established as facts blood-vascular and lymph-vascular angiomas, while usually benign, are potentially malignant endotheliomas, there is an intermediate stage between these two represented by the angio-endothelioma which is relatively benign but definitely malignant, and malignant endotheliomas of the blood-lymph-vascular system exist as a pathologic entity

Just as a malignant tumor of the skin is recognized as a squamous-cell epithelioma by its differentiation into horny, protective epithelium, so may certain of the blood-lymph-vascular tumors be recognized as endotheliomas by their differentiation into tumor blood-vessels

# BIBLIOGRAPHY

- <sup>1</sup> Aschoff, L. Das reticulo-endotheliale System. *Ergebn d inn Med u Kinderh*, 1924, vol. xxvi, pp 1-119
- <sup>2</sup> Bonnet, Robert. *Lehrbuch der Entwicklungsgeschichte*. Berlin, P. Parey, 2 ed, 1912, 485 pp
- <sup>3</sup> Brodeur, A. C. Squamous-cell Epithelium of the Lip. A Study of 537 cases. *Jour Am Med Assn*, 1920, vol. lxxiv, pp 656-661
- <sup>4</sup> Busman, G. J. Malignant Endotheliomas with Cutaneous Involvement. A Clinical and Histopathologic Study with a Report of Three Cases. *Arch Dermat and Syph* 1922, vol. vi, pp 680-700
- <sup>5</sup> Clark, E. R. Further Observations on Living Growing Lymphatics. Their Relation to Mesenchyme Cells. *Am Jour Anat*, 1912, vol. xiii, pp 351-379
- <sup>6</sup> Cohnheim, J. F. *Vorlesungen uber allgemeine Pathologie*. Berlin, A. Hirschwald, 2 ed, 1882, 2 vols
- Emmel, V. E. The Cell Clusters in the Dorsal Aorta of Mammalian Embryos. *Am Jour Anat*, 1916, vol. xix, pp 401-421
- <sup>7</sup> Eppinger, H. Ueber die Endothelioma. *Prag med Wchnschr*, 1876, vol. i, pp 82, 97
- <sup>8</sup> Evans, H. M. III. The Development of the Vascular System. In Keibel, F. and Mall, F. P. *Manual of Human Embryology*. Philadelphia, J. B. Lippincott Company, 1912, vol. ii, pp 570-709
- <sup>9</sup> Ewing, James. *Neoplastic Diseases, a Treatise on Tumors*. Philadelphia, W. B. Saunders Company, 1919, pp 28, 29, 312
- <sup>10</sup> Felix, W. Beitrage zur Entwicklungsgeschichte der Salomoniden. *Anat Hefte* 1897, vol. viii, pp 249-466
- <sup>11</sup> Ferguson, J. S. The Behavior and Relations of Living Connective Tissue Cells in the Fins of Fish Embryos with Special Reference to the Histogenesis of the Collagenous or White Fibres. *Am Jour Anat*, 1912, vol. xiii, pp 129-149
- <sup>12</sup> Goette, Alexander. Beitrage zur Entwicklungsgeschichte der Unke als Morphologiss Wirbelthiere. *Leipzig*, 1874
- <sup>13</sup> Hansemann, D. v. Ueber asymmetrische Zelltheilung in Epithelkrebsen und deren biologische Bedeutung. *Virchow's Arch f path Anat*, 1890 vol. cxix, pp 299-326
- <sup>14</sup> Hansemann, D. v. Ueber die Funktion der Geschwulstzellen. *Ztschr f Krebsforsch*, 1906, vol. iv, pp 565-577
- <sup>15</sup> His, Wilhelm. Ueber die Wurzeln der Lymphgefasse in der Hauten der Korpers und uber die Theorien der Lymphbildung. *Ztschr f wissensch Zool*, 1863, vol. xi, pp 223-254
- <sup>16</sup> Huntington, G. S. The Anatomy and Development of the Systemic Lymphatic Vessels in the Domestic Cat. *Philadelphia*, G. S. Huntington, 1911, 175 pp

# NEOPLASMS OF THE BLOOD-LYMPH-VASCULAR SYSTEM

- <sup>19</sup> Kampmeier, O F The Value of the Injection Method in the Study of Lymphatic Development *Anat Rec*, 1912, vol vi, pp 223-232
- <sup>20</sup> Kaufmann, E *Lehrbuch der speziellen pathologischen Anatomie* Berlin, W de Gruyter and Company, 1922, vol vii-viii, pp 139-140
- <sup>21</sup> MacCallum, W G A Text-book of Pathology Philadelphia, W B Saunders Company, 2 ed, 1920, p 201
- <sup>22</sup> MacCarty, W C The Histogenesis of Cancer (Carcinoma) of the Breast and its Clinical Significance *Surg Gynec and Obst*, 1913, vol xvii, pp 241-459
- <sup>23</sup> MacCarty, W C A Biological Conception of Neoplasia, its Terminology and Clinical Significance *Am Jour Med Sc*, 1919, vol clvii, pp 657-674
- <sup>24</sup> McClure, C F W The Development of the Lymphatic System in the Light of the More Recent Investigations in the Field of Vasculogenesis *Anat Rec*, 1915, vol ix, pp 563-579
- <sup>25</sup> McClure, C F W The Endothelium Problem *Anat Rec*, 1921, vol xxii, pp 219-237
- <sup>26</sup> Mallory, F B The Type Cell of the So-called Dural Endothelioma *Jour Med Res*, 1919-1920, vol xli, pp 349-364
- <sup>27</sup> Mallory, F B The Principles of Pathologic Histology Philadelphia, W B Saunders Company, 1914, p 275
- <sup>28</sup> Maximow, A Untersuchungen über Blut und Bindegewebe I Die frühesten Entwicklungsstadien der Blut- und Bindegewebszellen beim Säugetierembryo, bis zum Anfang der Blutbildung in der Leber *Arch f mikr Anat*, 1909, vol lxxiii, pp 444-561
- <sup>29</sup> Minot, C S I The Origin of the Angioblast and the Development of the Blood In Keibel, F and Mall F P *Manual of Human Embryology* Philadelphia, J B Lippincott 1912, vol ii, pp 498-534
- <sup>30</sup> New, G B Personal Communication
- <sup>31</sup> Reagan, F P Experimental Studies on the Origin of Vascular Endothelium and of Erythrocytes II The Local Origin Theory *Am Jour Anat* 1917, vol xxi, pp 44-48
- <sup>32</sup> Reagan, F P Vascularization Phenomena in Fragments of Embryonic Bodies Completely Isolated from Yolk-sac Blastoderm *Anat Rec*, 1915, vol ix, pp 329-341
- <sup>33</sup> Reichert, K B Beiträge zur Entwicklungsgeschichte des Meerschweinchens Berlin, F Dümmler, 1862, 216 pp
- <sup>34</sup> Robertson, H E 'Endothelioma' of the Pleura *Jour Cancer Res*, 1924, vol viii, pp 317-375
- <sup>35</sup> Ruckert J, and Mollier, S Die Entstehung der Gefässe und des Blutes bei Wirbeltieren In Hertig O *Handbuch der Vergleichenden und experimentellen Entwicklungslehre der Wirbeltiere* Jena G Fischer, 1906, vol 1, pp 1019-1278
- <sup>36</sup> Sabin, Florence R On the Origin of the Lymphatic System from the Veins and the Development of the Lymph Hearts and Thoracic Duct in the Pig *Am Jour Anat* 1902, vol i pp 367-389
- <sup>37</sup> Sabin Florence R Studies on the Origin of Blood-vessels and of Red Blood-corpuscles as Seen in the Living Blastoderm of Chicks During the Second Day of Incubation Contributions to Embryology Washington Carnegie Institute, 1920, vol ix, pp 213-262
- <sup>38</sup> Stockard C R An Experimental Study of the Origin of Blood and Vascular Endothelium in the Teleost Embryo *Anat Rec* 1915, vol ix, pp 124-127
- <sup>39</sup> Uhle J P and Wagner E *Handbuch der allgemeinen Pathologie* Leipzig, O Wigand, 1864, vol ix, 508 pp
- <sup>40</sup> White, C P The Definition, Terminology and Classification of Tumors *Jour Path and Bacteriol*, 1900, vol vi, pp 220-226
- <sup>41</sup> Wilson L B A Further Report of the Pathologic Evidence of the Relationship of Gastric Ulcer and Gastric Carcinoma *Am Jour Med Sc*, 1914 vol cxlviii, pp 796-810



# THE KLIPPEL-FEIL SYNDROME

NUMERICAL REDUCTION OF CERVICAL VERTEBRÆ

By THOMAS P NOBLE, M D , F R C S

SECTION ON ORTHOPEDIC SURGERY MAYO CLINIC

AND

JOHN M FRAWLEY, M B

FELLOW IN PEDIATRICS THE MAYO FOUNDATION

OF ROCHESTER, MINN

ANATOMIC variations may be found in any part of the spine, but much less frequently in the dorsal region where it is more stable than either the cervical or lumbosacral regions. The most common site is the lumbosacral region and in recent years, chiefly due to the work of Bertilotti, considerable attention has been directed to this site. Variations in the cervical region, although comparatively rare are varied and frequently multiple, nevertheless, they fall into two main types (1) the numerical reduction of the cervical vertebræ in which the main clinical picture is a short neck without or with only a minor degree of torticollis an anomaly usually associated with the names of Klippel and Feil and known in the European literature as Klippel-Feil syndrome, and (2) congenital torticollis of vertebral origin in which the shortening of the neck is of small import compared with the torticollis. The first of the two types will be discussed here. Only about thirty such cases are recorded in the literature and only one has been recorded in this country. All European countries have reported cases, but the French by far the greatest number. We wish to record two cases which have been observed in the Mayo Clinic within the last twelve months.

*Historical*—The historical description of congenital anomalies of the cervical spine may be studied from two points of view, the anatomic and the clinical. Anatomic variations in this part of the spine have been noted and described by anatomists for many years. Columbus in 1792 appears to have been the first, his description was soon followed by that of Moigagni. They both believed there were two types of fusion of the upper cervical vertebræ, the congenital and the acquired the acquired the result of an inflammatory process such as tuberculous disease or spondylitis, and the congenital, embryonic in origin and associated with other congenital defects. Elliot Smith, in 1908, recorded twelve cases of fusion of the atlas to the occipital bone, six of which were compiled by Wood Jones from the cemeteries of lower Nubia, five from ancient Egyptian cemeteries, and one from the anatomical department of the medical school at Cairo. Macalister in the anatomical collection at Cambridge found occipito-axial fusion in 14 per cent of skulls and Franck-Russell found 4 per cent of 455 skulls of ancient and modern Americans in the Peabody Museum at Harvard. Gladstone and Wakeley in 1925 record seven cases of congenital anomalies of the cervical

spine among the specimens in the museum of King's College. In two of these cases there was a fusion of the atlas with the occipital bone, and in five an occipital vertebra.

The clinical records of such cases are much more recent. The earliest clinical description appears to be that of Jackson Clarke, who read the notes of a case before the Clinical Society of London. The patient was a boy, aged four years, whose chin, since birth, had been very close to the sternum, the head was fixed so that there was no movement of the cervical spine. The roentgenogram showed extensive bony abnormalities of the upper dorsal and cervical regions and a cervical rib on each side. The details of the operation are not given, but the child was said to have been improved. In 1912, the classical case of Klippel and Feil was described with extensive clinical and pathologic detail. The patient was a tailor aged forty-six, whose head appeared to be resting on the trunk as if from suboccipital Pott's disease, the hair was implanted low and all movements of the head were greatly limited. He died in the hospital from pulmonary congestion and nephritis. At necropsy the thoracic cavity was normal but the spinal column showed considerable variations from normal and could be divided anatomically into three portions: (1) a cervicodorsal mass with a spina bifida posteriorly, this mass possessed neither atlas nor axis and was probably formed by four dorsal vertebrae, (2) the dorsal vertebrae, eight in number and normal in shape, the first being fused to the cervical mass, and (3) the lumbar spine made up of four vertebrae, the fifth one being fused to the sacrum. In reviewing the vertebral column as a whole, there were only twelve well-differentiated vertebrae, four lumbar and eight dorsal, in place of the normal twenty-four. There were twelve pairs of ribs, each of the eight dorsal vertebrae possessed one pair, and the cervicodorsal mass possessed four pairs, described as cervical ribs. Since this classical description, numerous cases have been recorded in the literature, especially the French and Italian. In 1919, Feil compiled all the reported cases and published them in the form of a thesis.

*Morphology and Anatomy*.—From the point of view of development the skull is divided into two parts, the preotic and the postotic. The preotic, or non-vertebral part, is the anterior, and is regarded as a new formation to receive the greatly developed brain and afford protection to the organs of sight and smell. The postotic part is posterior and is of vertebral origin, the more anterior sclerotomes have been fused together to form this portion of the skull. According to Froniep, the mammalian occiput corresponds to the fusion of four vertebrae and probably in some classes of vertebrates the occipital region of the primordial cranium is increased by fusion of the upper cervical vertebrae with a consequent diminution in length of the cervical region. In the course of evolution, the craniovertebral articulation appears to have been shifted backward, one vertebra after another having been absorbed into the skull to form the postotic segment. Many anatomists consider congenital fusion and assimilation of the atlas into the occipital bone a further stage in the process of evolution but when the vertebral column is considered as a

whole in such cases, it is found sometimes to be actually lengthened. After the original error there is a tendency for the spine to assume the normal proportions.

*Atlanto-occipital Fusion*—Swjetschnikow, some years ago, made a careful study of this anomaly and published a very complete monograph on the subject. He divided the condition into three types: (1) those acquired as the result of tuberculosis, syphilis or arthritis, (2) those acquired by the fetus in utero as the result of pressure in an abnormal pelvis, and (3) those purely



FIG. 1.—Photograph taken in lateral position showing the shortness of the neck.

congenital, in which, during the process of growth, the sclerotomes which develop into the cranium become abnormally attached to the sclerotome of the first cervical segment. The first type will not be considered here as it is entirely an acquired disease. The second type is known as the basilar kyphos of Vichow, and is characterized by a circular depression around the foramen magnum in which the condyles are situated. The occipital bone is pushed downward, taking with it the mastoid processes and overhangs the first cervical vertebra. Several theories exist as to the nature of this type of abnormality. Bertolotti regards it as a congenital malformation of the cervical spine, Schultznass and

Meyer believe it is caused by muscular action, and Vichow and Grawitz that it is due to loss of bony substance. The third type, which is an occipitalization of the atlas, may exist without other anomalies, but it is frequently accompanied by other malformation such as hæmivertebra, numerical reduction of the vertebra, and spina bifida. It is the most frequent cause of osseous torticollis and may occur in a unilateral or a bilateral form. If unilateral the head is inclined to the occipitalized side, the degree of the torticollis depending on the gravity of the fusion. The head is not always fixed and there is often some contracture of the muscles of the neck, thus combining a muscular and an osseous torticollis. If the form is bilateral, the symmetry is rarely perfect, so that there is often a minor degree of torticollis. This

## THE KLIPPEL-FEIL SYNDROME

condition is not always noticed at birth but usually becomes apparent between the fifth and tenth years of life

*Clinical Manifestations*—The clinical picture of this disease has changed but little since the classical description of Klippel and Feil in 1912. The condition is not incompatible with long life as it has been noted in persons seventy years of age. Heredity does not appear to be an influence, nor are there any familial characteristics. The compiled records show that it is more common in males than in females.

The symptoms may be divided into primary and secondary. The primary symptoms are shortening of the neck, low implantation of the hair and limitation of the movements of the head. The head appears to sit directly on the top of the thorax, in many cases as if there were no neck. The hair extends directly onto the thorax, and in consequence of the osseous anomalies there is considerable limitation of the movements of the head. The secondary characteristics are the direct result of the



FIG. 2—Röntgenogram showing that two cervical vertebrae are missing

altered relationship between the shoulder girdle and the thoracic cavity. The back is generally round, with varying degrees of scoliosis, due to the fact that the thorax has risen to the occiput. With the rising of the thorax the nipples assume a slightly lower level than normal. The scapulæ, unlike the nipples, rise with the thorax, and this, together with the disproportion between the length of the limbs and the trunk, give a simian appearance to the patient. The chin sits directly on the sternum and is frequently underdeveloped. The opening of the mouth is restricted and the teeth frequently grow in an oblique direction. There may or may not be a spina bifida. If there is a gap in the posterior arches of the cervical vertebrae it is not a true spina bifida, but merely an arrested development and purely an osseous lesion. It corresponds

to the so-called spina bifida occulta which is so common in the first sacral segment. In all the recorded cases of the Klippel-Feil syndrome, there is a complete absence of all nervous and cutaneous lesions. The head as a rule is not quite straight, and there is generally a minor degree of torticollis.

*Etiology*—Many hypotheses have been put forward to explain congenital anomalies of the spine, such anomalies are rarely single but are generally associated with variations in other parts of the body. Variations in one part of the spine are very frequently compensated for by variations in another part. Gladstone and Wakeley seem to us to have provided the simplest explanation. They regard congenital variations not as a regressive or progres-



FIG. 3.—Anteroposterior position

sive tendency in phylogeny, but rather as the result of a morbid condition interfering with the normal development of the fetus. Many of the variations cannot be classified as defects, for frequently an additional part such as a cervical rib or a supernumerary digit is formed. The normal tendency of the parental stock to transmit is weakened and it is unable to produce a like offspring. An unstable condition in the development of the fetus is produced which induces variations in development. These unstable conditions may be produced by unhygienic conditions or disease affecting either parent.

*Rontgenology*—When rontgenograms of this condition are taken certain definite positions must be used to bring out the anomalies. These positions have been very carefully studied and described by Feil. Rontgenograms should portray first the spine as a whole, so as to give a general idea of the sites of anomaly, and, second the local condition and relations of the cervical segments. In pictures of the spine as a whole three positions are necessary. An oblique anterior taken from the right or left, an anteroposterior, and a lateral. Localized rontgenograms should be taken through the mouth and by axial projection from the base of the skull in order to get images of the atlas and axis, and the occipitovertebral and allanto-axial articulations.

*Pathologic Anatomy*—Very few actual pathologic specimens have been studied, most of our knowledge of the pathologic anatomy of this disease is

## THE KLIPPEL-FEIL SYNDROME

based on roentgenologic examinations. Considerable variations are shown, from the absence of a single cervical vertebra to complete absence of the cervical spine. Feil recognized three types: complete absence of the cervical spine, partial numerical reduction of the cervical vertebrae, and partial reduction not confined to the cervical vertebrae, but extending throughout the whole spine.

In two-thirds of the cases a large triangular opening occupies the posterior part of the vertebrae and in some cases extends from the cranium to the thoracic region. The thorax ascends to the skull forming a cervical thorax. The atlas is often fused to the occipital bone and there is almost always a basilar or craniocervical kyphosis.

### REPORT OF CASES

CASE I—A male child, aged fourteen months, was brought to the Mayo Clinic, March 25, 1925, on account of shortness of the neck. At his birth the parents noticed that his neck was very short, and later that the rotation of the neck was greatly restricted. In July, 1924, the neck was roentgenographed by their home physician, who discovered that some of the cervical vertebrae were missing. There is no history of short neck in the family.

The baby was fat and healthy. Besides the very short neck and its limited rotation, there was also a cleft in the soft palate. Roentgenograms showed that two cervical vertebrae were missing. A diagnosis of Klippel-Feil syndrome was then made (Figs. 1 and 2).

CASE II—A female child, aged three years, was brought to the Mayo Clinic, September 30, 1924, because of shortness of the neck. The parents had noticed that the neck had been abnormally short since birth. The child was otherwise healthy. Roentgenologic examination revealed an absence of two cervical vertebrae. A diagnosis of Klippel-Feil syndrome was made (Figs. 3 and 4).

### CONCLUSIONS

Numerical reduction of the cervical vertebrae is a comparatively rare congenital anomaly, but undoubtedly is more common than the literature would lead one to believe. The clinical appearances of patients with this anomaly are characteristic. The pathologic changes may vary from absence of one or two cervical vertebrae to complete absence of the whole cervical spine.



FIG. 1.—Lateral position.

BIBLIOGRAPHY

- <sup>1</sup> Bertillotti Le anomalie congenite del Rachide cervicale Putte chir del organi di movimento, 1920, pp 395-499
- <sup>2</sup> Clarke, J J Congenital Deformity of the Cervical Spine, Treated by Operation Lancet, 1906, vol II, p 1350  
Columbus Quoted by Bertillotti
- <sup>3</sup> Feil, A L'absence et la diminution des vertebres cervicales Paris, 1919, 123 pp
- <sup>4</sup> Feil, A Comment doit-on radiographier la colonne cervicale quand on soupconne l'existence d'une anomalie? Jour Rad et d'electrol, 1923, vol VII, pp 125-133
- <sup>5</sup> Franck, Russell Quoted by Bertillotti
- <sup>6</sup> Friorip Text-book of Anatomy Cunningham, Pentland Brothers, 1906, 2 ed
- <sup>7</sup> Gladstone, R J, and Wakley, C P G Variations of the Occipito-atlantal Joint in Relation to the Metameric Structure of the Cranio-vertebral Region Jour Anat, 1925, vol LX, pt 2, pp 195-216
- <sup>8</sup> Grawitz, Paul Beitrag zur Lehre von der basilaren Impression des Schädels Virchow's Arch f path Anat u Physiol u klin Med, 1880, vol LXXX, pp 449-474
- <sup>9</sup> Klippel and Feil Un cas d'absence des vertebres cervicales Nouvelle Iconographie de la Salpêtrière 1912, pp 225-250
- <sup>10</sup> Macalister Quoted by Bertillotti
- <sup>11</sup> Meyer, L Der skoliotische Schädel Arch f Psychiat 1877, vol VIII, pp 108-130
- <sup>12</sup> Morgagni Quoted by Bertillotti
- <sup>13</sup> Schultznass Schadelassymetrie bei congenitalen Skoliose Ztschr f orthop Chir, 1908, vol XL
- <sup>14</sup> Smith Elliot The Significance of Fusion of the Atlas to the Occipital Bone and Manifestation of Occipital Vertebrae Brit Med Jour, 1908 vol II, pp 594-596
- <sup>15</sup> Swjetschnikow Ueber die Assimilation des Atlas und die Manifestation des Occipitalwirbels beim Menschen Arch f Anat u Entwicklungsgesch, 1906, pp 155-194
- <sup>16</sup> Virchow Quoted by Grawitz

## HORSESHOE KIDNEY\*

By DANIEL N. EISENDRATH, M.D., FRANK M. PHIGER, M.D.

AND

HARRY B. CULVER, M.D.

OF CHICAGO, ILL.

DEFINITION—As stated in a previous article<sup>1</sup> we believe that the term “fused kidney” should be discarded. In its place we should employ the following terms to designate the respective conditions

1. Crossed Ectopia—To be used for those cases in which both kidneys

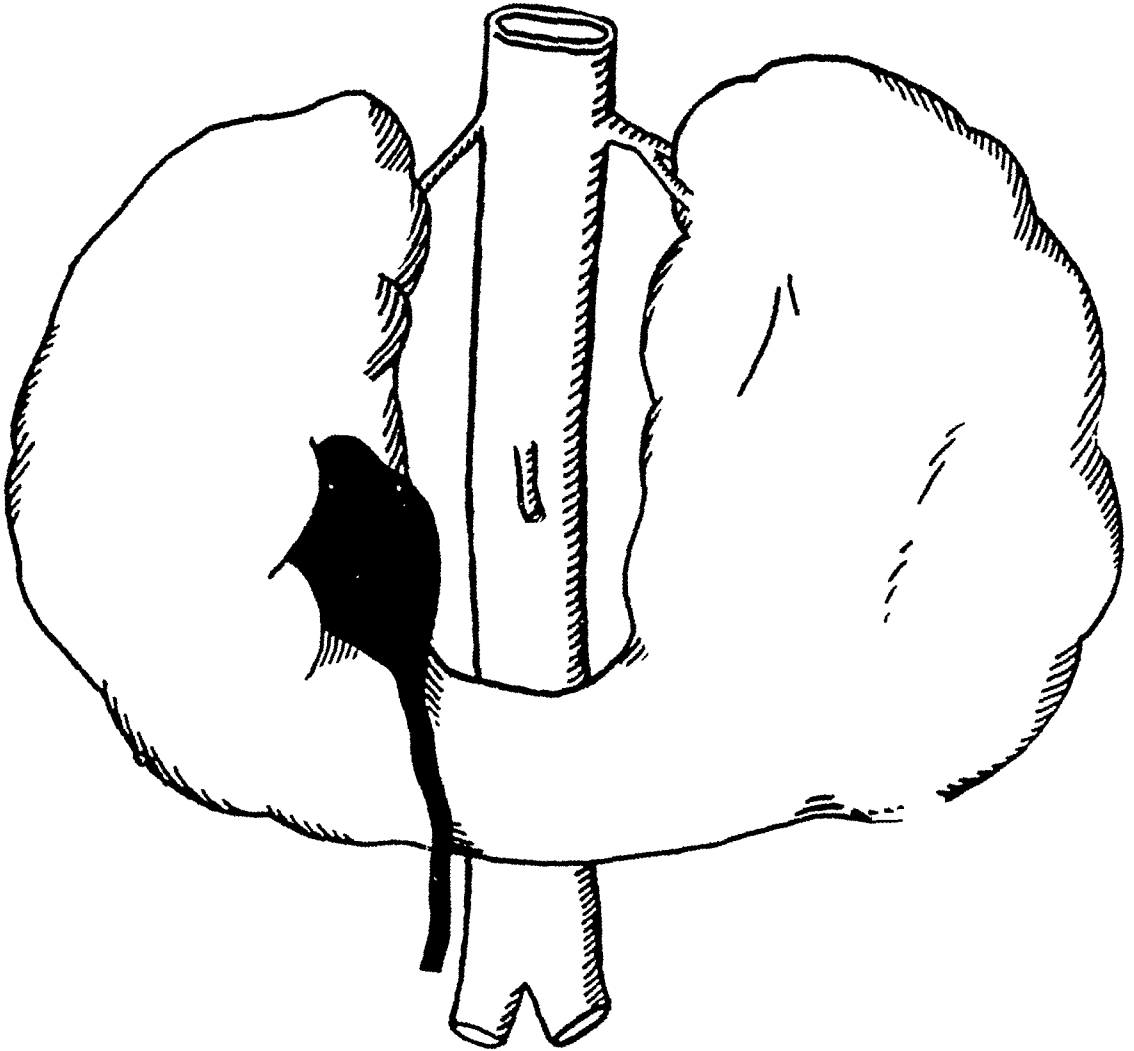


FIG. 1.—Horseshoe kidney with symmetric halves. (Drawing made from specimen in Rush Medical College Museum.)

are found on the same side of the body. They may be fused into one mass or be separated. The lower of the two kidneys corresponds to the one which in the embryo should have been found on the opposite side of the body.

2. Double Kidney—To be used for those cases in which there is a reduplication either complete or incomplete of the ureter and a corresponding

---

\* From the Cook County and Michael Reese Hospitals.



reduplication of the renal pelvis on one or both sides of the body. The parenchyma around the respective pelves of each half of the kidney may fuse, or the two halves may be more or less separated.

3 Horseshoe Kidney—The two kidneys of opposite sides of the body are connected across the spine by an isthmus which may consist only of

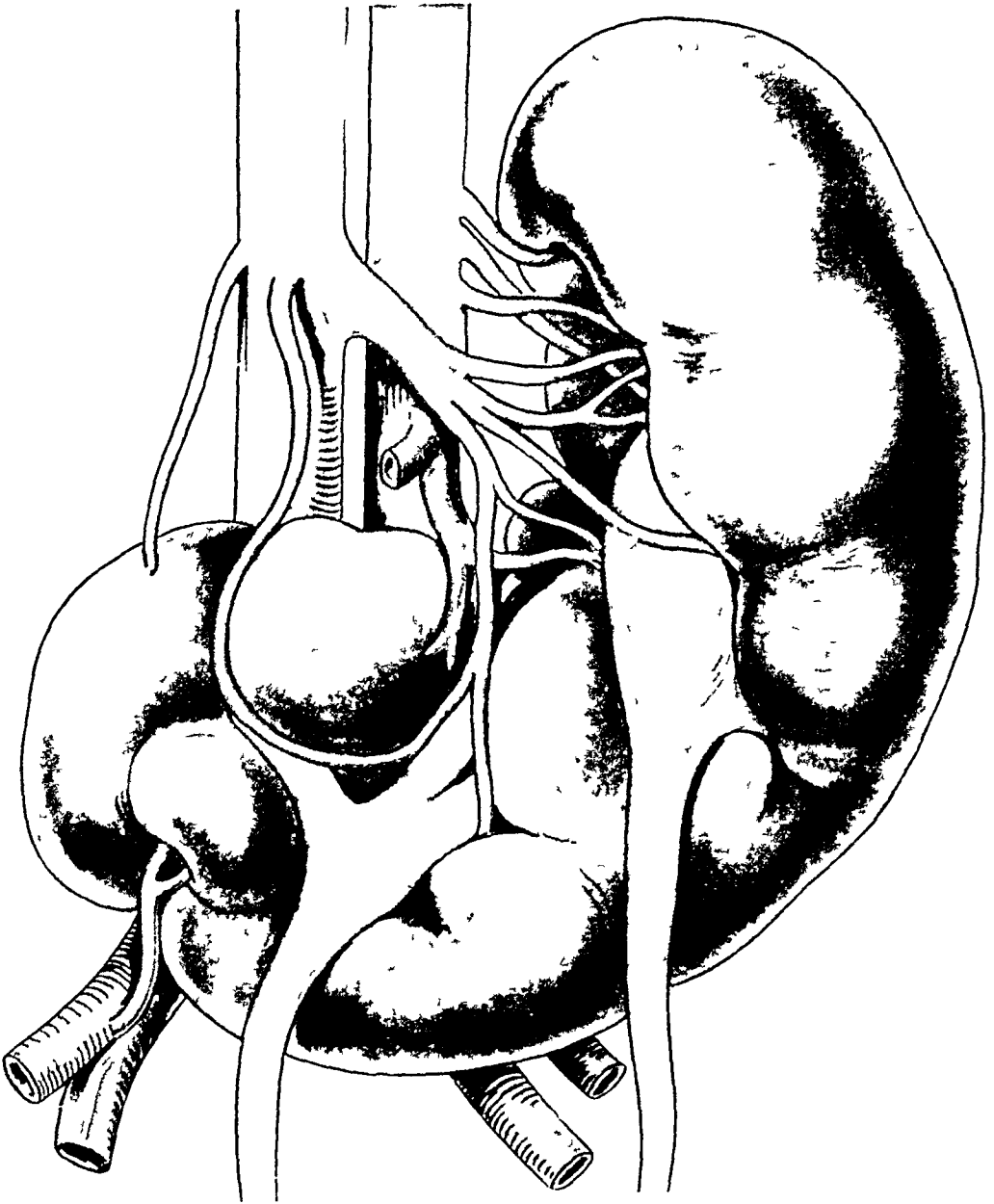


FIG. 21.—Horseshoe Kidneys with asymmetric halves. (One-half at higher level. (Rush Medical College Museum).)

fibrous tissue or of parenchyma. The isthmus varies greatly in width and as to whether it connects the upper or lower poles.

4 Cake or L. Kidney—These are simply sub-varieties of the horseshoe kidney. If the isthmus which extends across the spine is so wide that it connects the two kidneys along their entire mesial borders, we speak of a cake

## HORSESHOE KIDNEY

kidney (Fig 7) If one-half of the horseshoe kidney is elongated so that the other half only is united to its lowermost portion, we speak of an L kidney (B of Fig 2)

1 *Frequency of Horseshoe Kidney*—Botez<sup>2</sup> collected the statistics of

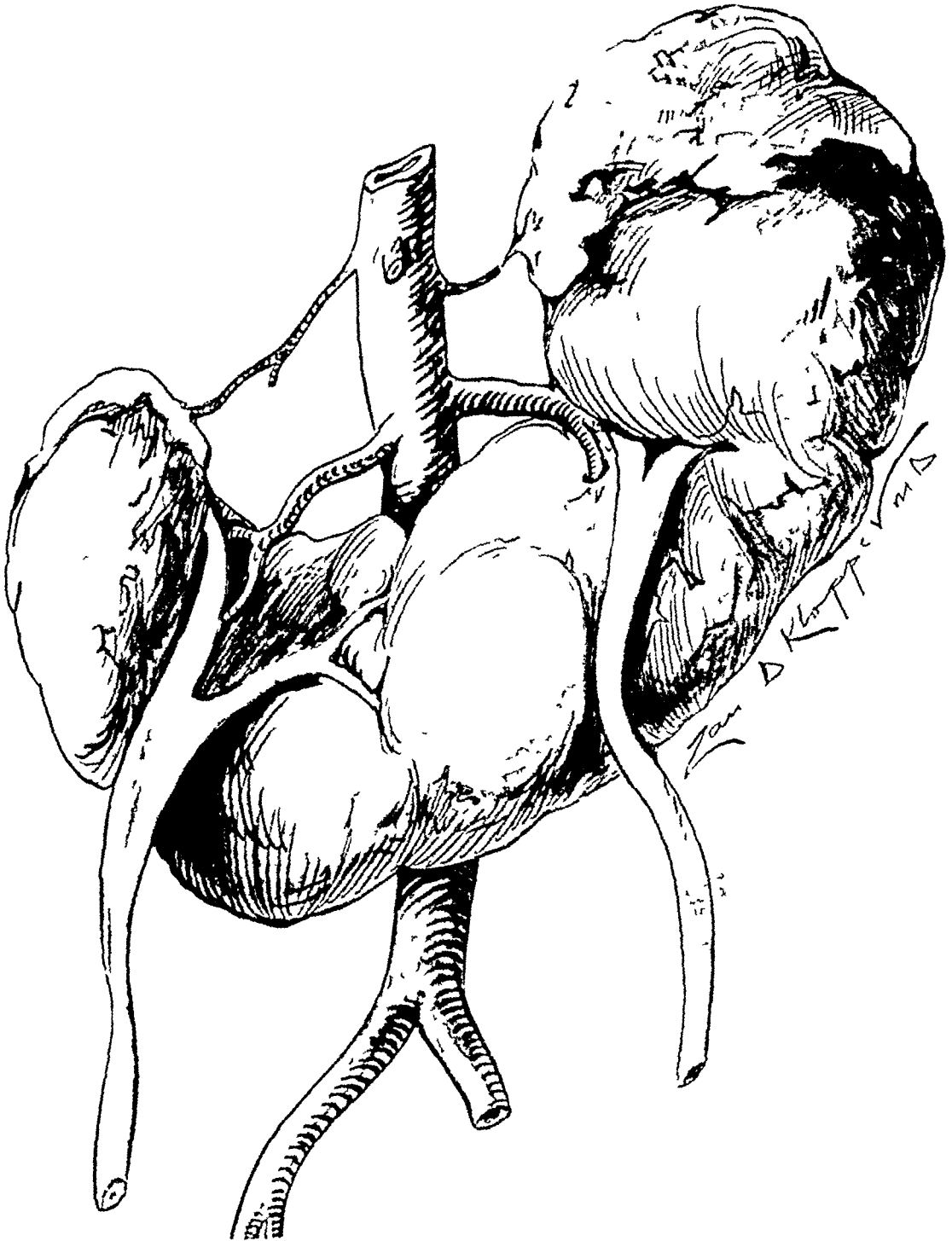


FIG. 2b.—Horseshoe kidneys with asymmetric halves. The two halves form an L-shaped mass (Garre and Ehrhardt case)

51 504 autopsies published by various authors up to 1912. Horseshoe kidney was found in 72 of these, or 1 to 715 autopsies. Carlier and Gerard,<sup>3</sup> in 1913, added some later observations to those of Botez, finding that this anomaly occurred eighty times in 69 989 autopsies or 1 to 862. Since 1913,

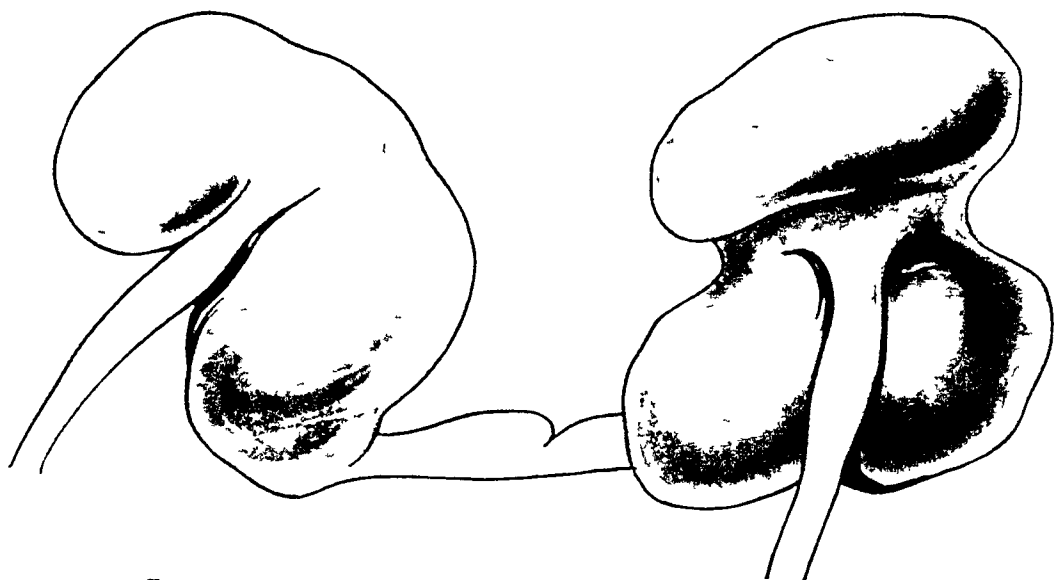


FIG. 3—Well marked fibrous isthmus joining the two halves (Küster case)

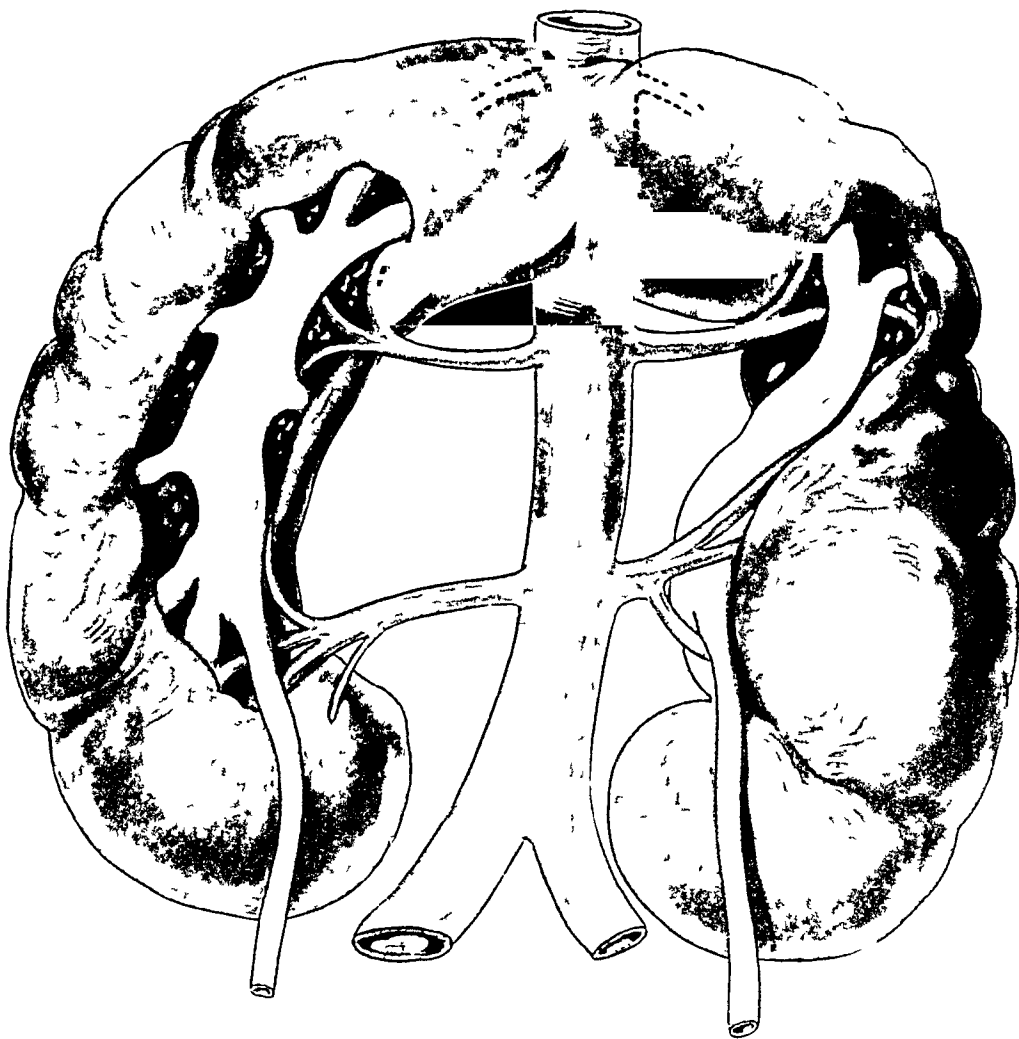


FIG. 4—Horseshoe kidney with superior isthmus (Byron Robinson case)

the observation of Motzfeld<sup>4</sup> can be added, making a total of 73,489 autopsies in which horseshoe kidney was found in 92, or approximately 1 in 710 bodies

2 *Relation of the Two Halves*—Horseshoe kidneys may be divided as follows

1 Symmetric—Both halves approximately equal in size and at the same level (Fig 1)

2 Asymmetric—Inequality in size and level of the two halves (Fig 2) One side may be hypoplastic and the other the size of a normal kidney, or one side may be of normal size and the other so elongated as to form together a V or L-shaped mass (Fig 2)

As a rule the two halves are situated an equal distance from the spine, but it is well to remember in our radiographic study of suspected cases that one or both halves may be as far away from the spine as is the normal kidney, or on the other hand, that one-half may be quite close to the spine and the other not (Fig 14) It is not uncommon to find a hypoplasia of one-half and a



FIG 5—Isthmus composed of both cortex and medulla. The isthmus joined the upper poles (Bactzner case)

compensatory increase in size of the other half. As a rule the lower poles converge as is true in the embryo (Broman) and hence the renal shadows and pyelograms or calculous shadows (Fig 15) are often directed obliquely inwards. The upper poles in some cases are very far apart and the angle which the halves form with the spine wider than when the upper poles are a normal distance apart

3 *The Isthmus, etc*—(a) Inferior and superior. Byron Robinson<sup>7</sup> found the isthmus joining the lower poles in 88 per cent of his observations. Beyer<sup>6</sup> found such an inferior isthmus in 93 per cent and Gerard in 91 per cent so that one can say that it is so located in about 90 per cent of the cases. The superior polar isthmus occurs in the remaining 10 per cent (See Fig 3)

(b) *Width and Character of Isthmus*—This was fibrous in (Fig 4) seven cases. Robinson (*loc cit*) estimates that this condition exists in 15 per cent of all cases, but this appears too high a percentage. In the majority of cases the isthmus is composed of parenchyma, so that there is no demar-

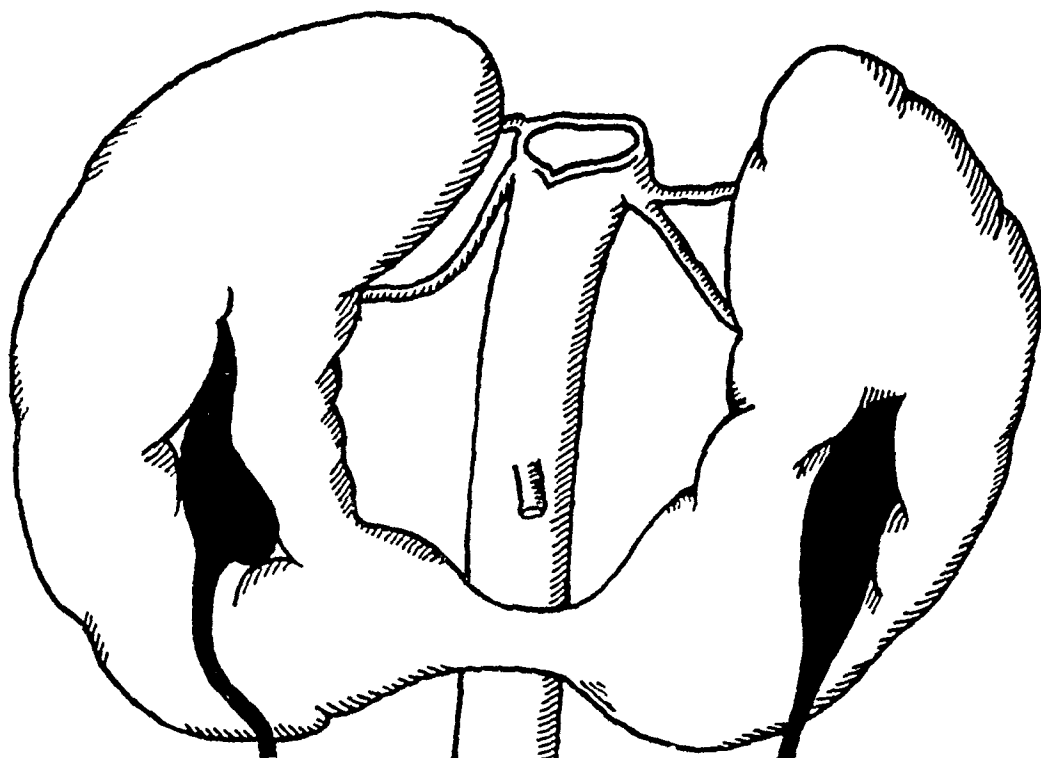


FIG 6a —Specimen in Rush Medical College Museum illustrating variation in width of isthmus Compare with Figs 3 6b and 7 to understand how the cake kidney originates

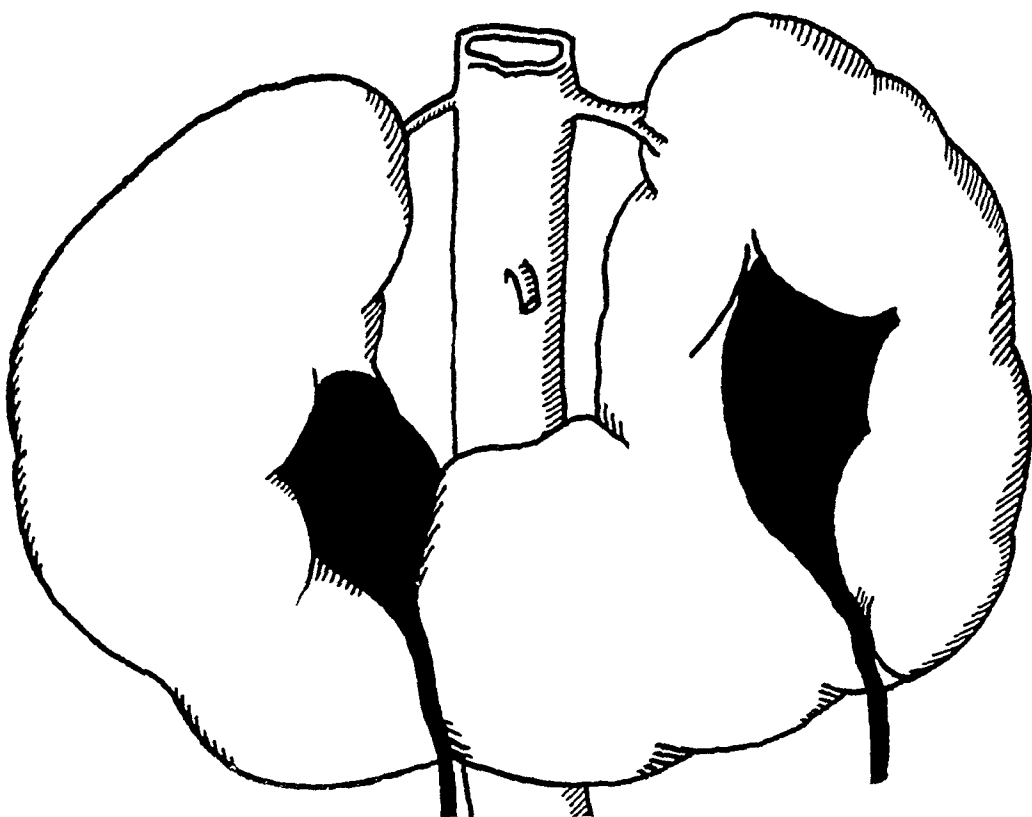


FIG 6b —Specimen in Rush Medical College Museum illustrating variation in width of isthmus Compare with Figs 3 6a and 7 to understand how the cake kidney originates

cation between the two halves (Fig 5) The isthmus in a vertical direction measures from 2 to 3 cm in the majority of cases

(c) *Transition to Cake Kidney*—The isthmus may unite a variable proportion of the two halves as a rule only the poles but it may fuse together more than the 2 to 3 cm just mentioned so that all degrees (Fig 6 a and b) are found up to that of complete fusion to which the name cake kidney (Fig 7) has been given Here there is a solid mass of renal tissue without any mesial demarcation

(d) *Relation of Isthmus to Aorta*—In only two cases viz those of Nixon<sup>7</sup> and Kelly<sup>8</sup> was the isthmus behind the aorta

4 *Renal Pelves*—In the majority of cases there is a single pelvis on each side (Fig 1) Reduplication of the ureters and of the pelves on one or both sides is not rare (Fig 8)

The pelvis is usually on the anterior (ventral) aspect of the kidney (Fig 1) at the level of the normal hilus and resembles that of the normal organ in respect to being a single cavity with its calyces located either partly external to the hilus or not extending beyond it, i.e. intra-renal In horseshoe

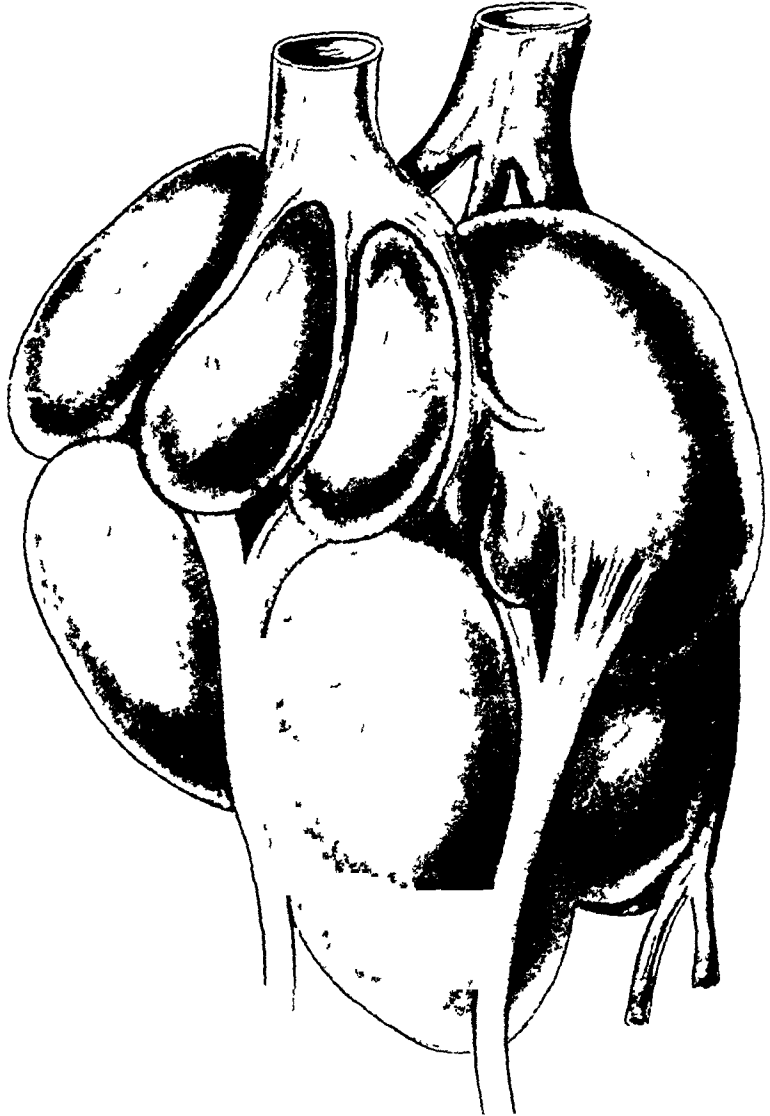


FIG 7—Typical cake kidney (Papin)

kidney a true pelvis of this kind is often absent the calyces being all extra-renal and ending independently in the ureter (Fig 9)

5 *Ureters*—As a rule the ureters pass across the front of the isthmus and this accounts for the frequency with which calculi hydronephrosis, etc occur Robinson found that the ureters passed behind the isthmus (Fig 10) in 9 per cent of his specimens but this figure would seem too high inasmuch as only two reports viz those of Landouzy<sup>9</sup> and Durham<sup>10</sup> have been published of ureters behind the isthmus The latter according to Robinson and other observers at times has an independent ureter In Karl Joseph's case this isthmian ureter ended independently in the bladder Perruchet<sup>11</sup>

describes a case in which one ureter passed behind the other in front of the isthmus. As a rule calyces are only present in the upper two-thirds of each half, but an extrarenal calyx or an independent ureter may drain the isthmus (Fig 9) and be opened during the operation of division of the isthmus or of heminephrectomy. The ureters usually end in the bladder at the normal location, but it must be remembered clinically that one ureter may end ectopically (Fig 11) as is so often the case in double kidneys.

6 *Location of Horseshoe Kidney*—This is usually lower, just above the aortic bifurcation (Fig 1), but it may be anywhere from the normal level of

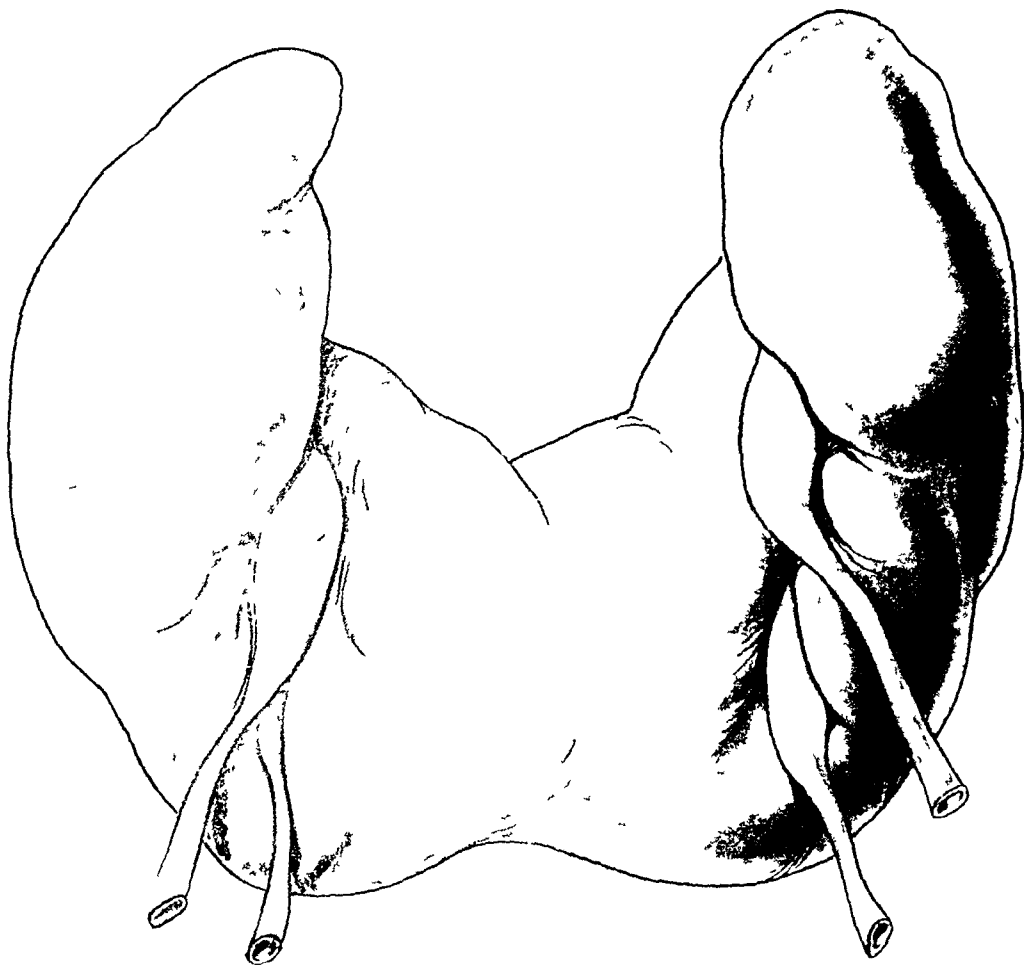


FIG. 8.—Horseshoe kidney with two ureters and two pelvis for each half (Byrom Robinson case)

the kidneys to the true pelvis (Fig 12). Such a pelvic ectopia is not uncommon. Only seven cases are reported in which the isthmus was at the normal level of the lower poles. In Rathbun's<sup>12</sup> case one-half of the horseshoe kidney was in the true pelvis. The majority of horseshoe kidneys which lie in the true pelvis are of the cake (Fig 7) variety, *i.e.* have completely fused halves. The isthmus is usually at the level of the fourth to fifth lumbar vertebrae and may not be in the median line. There is very little mobility as a rule in a horseshoe kidney, but a few cases have been reported in which marked mobility existed. The fixation of a horseshoe kidney is in great

# HORSESHOE KIDNEY

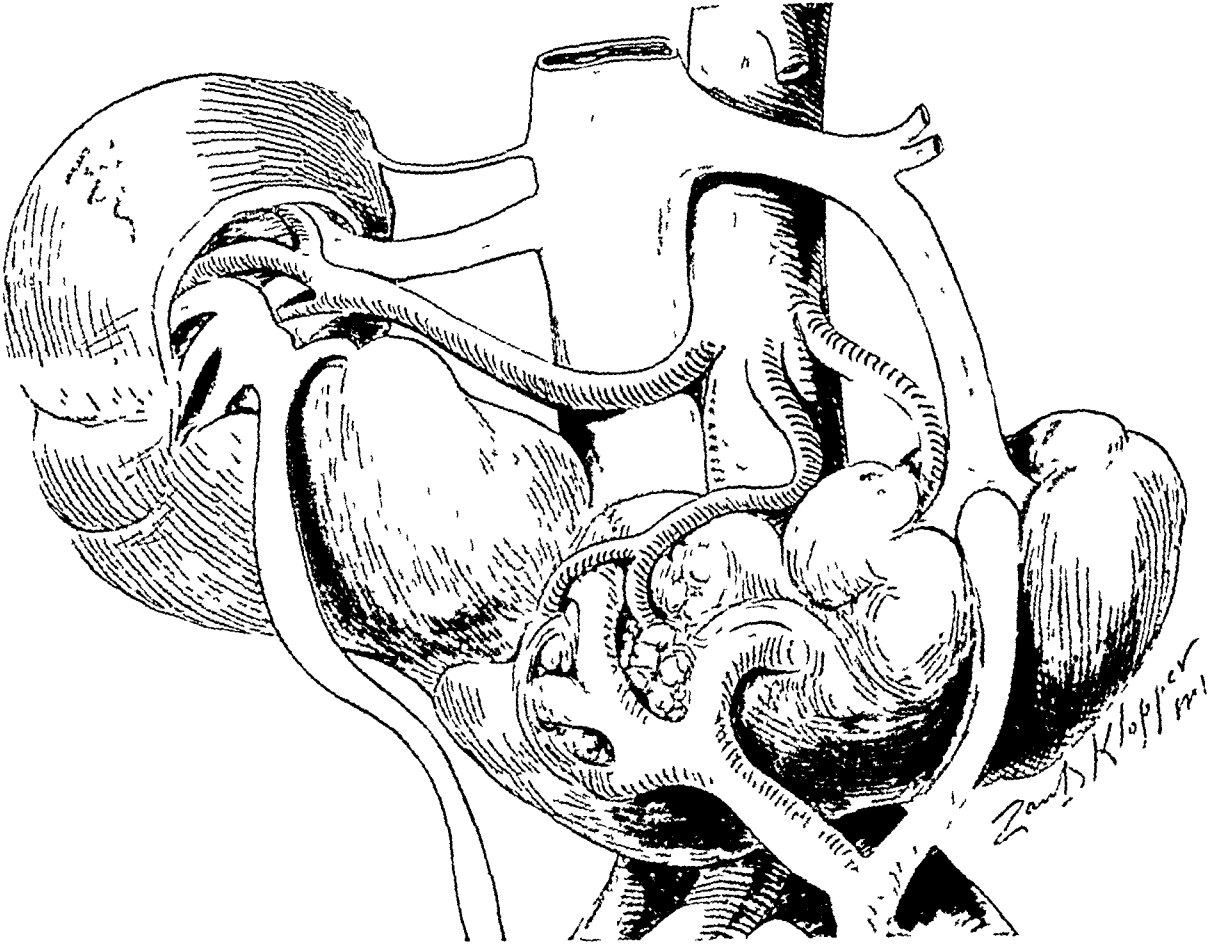


FIG 9 —Horseshoe kidney with extrarenal calyces ending directly in left half, into ureter  
(Rush Medical College Museum )

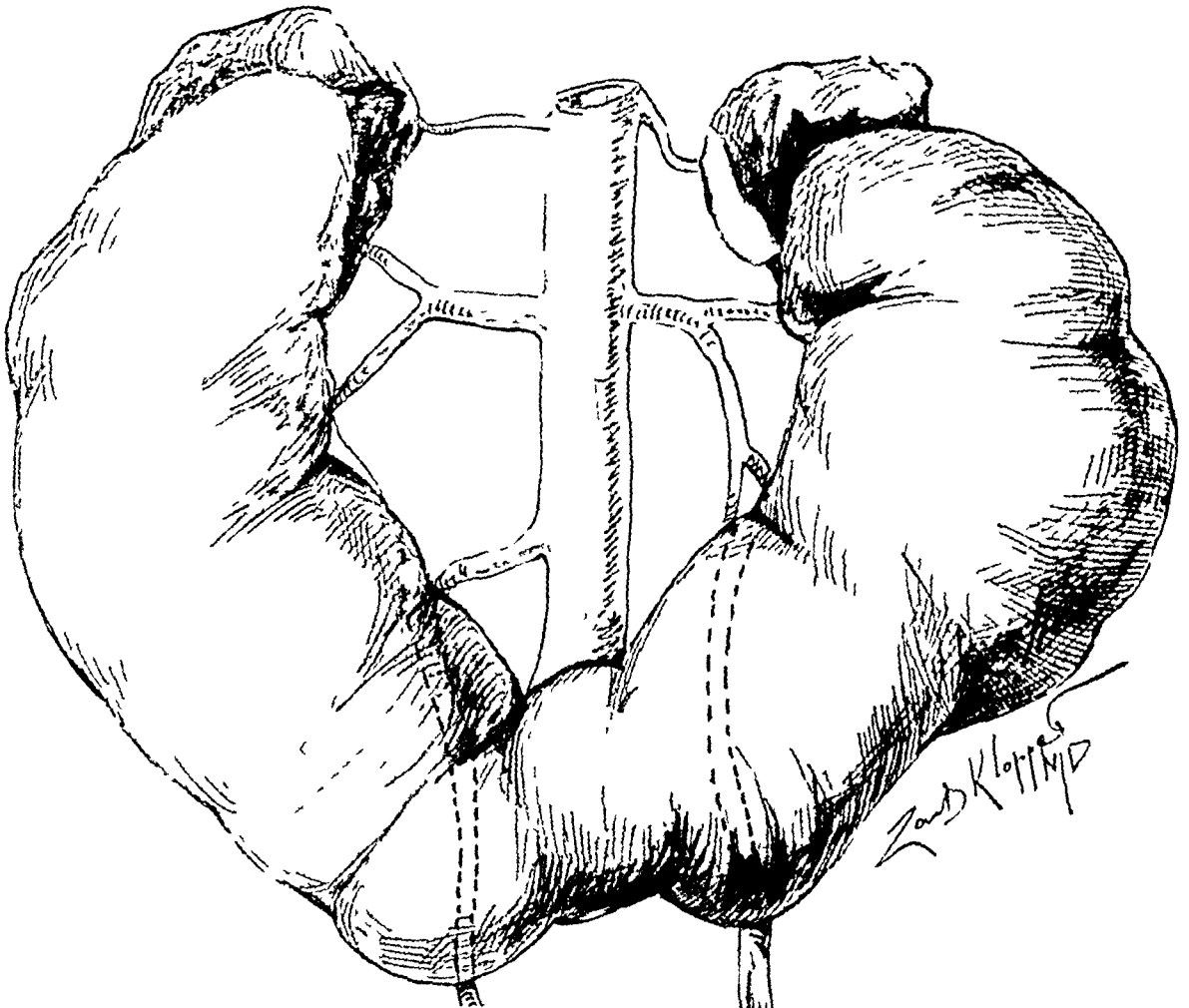


FIG 10 —Horseshoe kidneys with symmetric halves in which ureters crossed posterior aspect of isthmus  
(Rush Medical College Museum )



measure due to the fact that it has multiple blood-vessels supplying it, all from immediately adjacent trunks. There is but little perinephric fat, hence this does not play a rôle in fixation of the horseshoe kidney.

7 *Blood Supply*—It is important from the operative standpoint to remember that multiple arteries and veins for each half and often for the isthmus as well, are found in eighty per cent. In a study of 139 cases, including 10 of his own, Pappin<sup>1</sup>

found the following:

(a) A single artery for both halves in only one case (Brunchet).

(b) One artery for each half in 25 cases (A of Fig 13).

(c) One artery for each half and one for the isthmus (B of Fig 13).

This is almost the normal condition. There were 40 cases in this group.

(d) Two arteries for each half and one for the isthmus (C of Fig 13).

The one for the isthmus is an aortic branch. There were 26 cases in this group.

(e) Two arteries for each half and one or two for the isthmus. The former are given off by either the aorta or the common iliacs. The latter (isthmic branches) arise from the iliacs (C of Fig 13). Twenty cases belonged to this group.

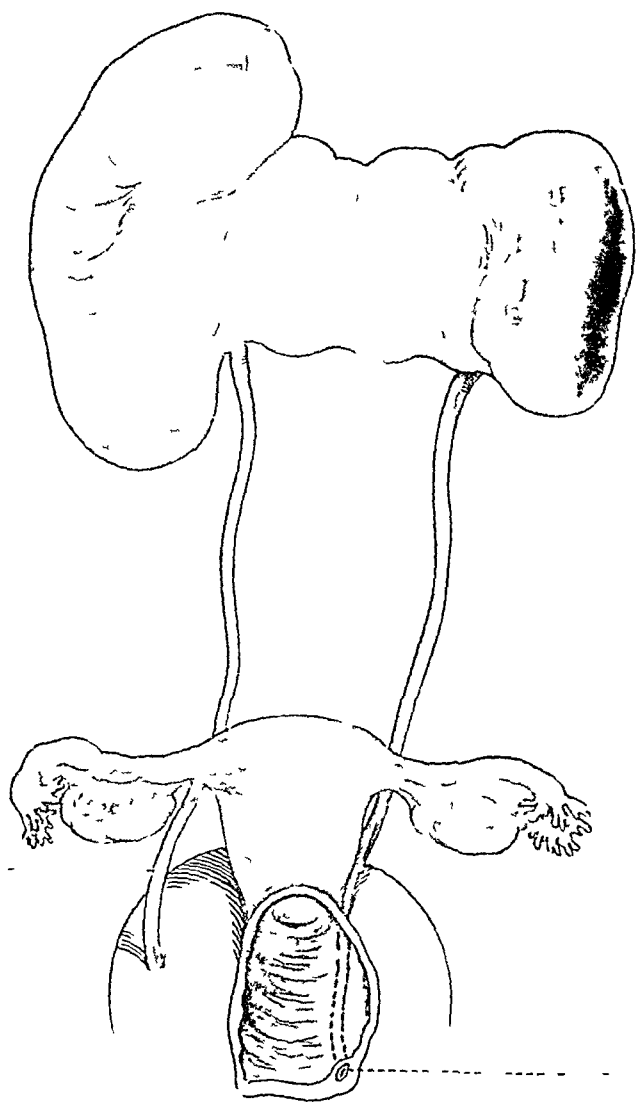


FIG. 11.—Horseshoe kidney with relatively wide isthmus. One ureter ends just below external meatus (Female) (Massari case).

In the remaining groups there were from six to eight arteries for the two halves. The important deductions are that one must have an adequate exposure of the operative field because (a) of the multiplicity of the vessels, both arteries and veins, which supply both halves and the isthmus, and (b) because they may arise from the aorta or end in the vena cava respectively, or similarly from the iliacs.

# HORSESHOE KIDNEY

## CLINICAL IMPORTANCE OF HORSESHOE KIDNEY

1 *Factors Favoring Pathologic Conditions*—(a) Course of ureter across isthmus This is perhaps the most important, because of the sharp bend which must be made by the ureter across the more or less thick and hard isthmus (Fig 1) Infections of the kidney involving the ureter secondarily are more apt to cause obstruction through fixation and kinking than in the case of the normal ureter

(b) The abnormal location of the pelvis on the ventral aspect of the kidney and the fact that the ureteral insertion is often at a higher point than the bottom of the pelvis and the frequent absence of a pelvis proper (Fig 9), all favor stagnation of urine and subsequent infection (Figs 17 to 20)

(c) The frequent occurrence of congenital strictures of the ureter in horseshoe kidneys

(d) The presence of many accessory vessels and the possibility of ureteral obstruction by them

2 *Published Clinical Cases* Botez (*loc cit*) collected all clinical reports up to 1912 and included several unpublished ones (Marron) in his article Of a total of fifty

of Botez's cases, only 39 are of value from the operative standpoint Since 1912, we have found reports of ninety additional clinical cases and with our own, reported in this article, we have a total of 132 up to July, 1925 (See Tables I to VII inclusive)

We will report our three cases before taking up the subject any further

CASE I—*Pyelotomy for renal calculus in one-half of a horseshoe kidney Presence of this anomaly diagnosed before operation*

Male, aged thirty-two, complained of pain in right lumbar region radiating to right upper quadrant of abdomen, of two days' duration In addition to tenderness over the right iliocostal space, there were other evidences of acute renal infection Radiography (Dr Cora M Matthews) revealed an oval vertical shadow (A of Fig 14) lying over the transverse process of the second lumbar vertebra, i.e., closer to the spine than shadows of renal or ureteral calculi usually do The right opaque catheter curved slightly out-

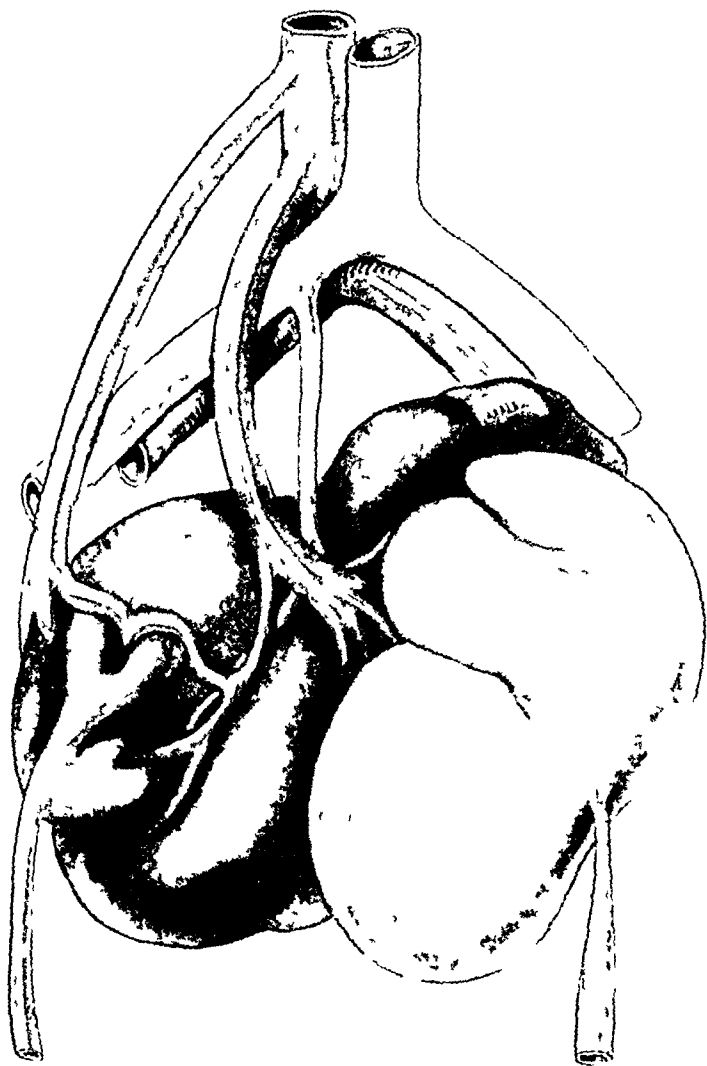


FIG 12—Hydronephrosis of left half of pelvic ectopic cake kidney (Heimer)

TABLE I  
*Division of Isthmus Alone (Symphysiotomy) or Combined with other Operations*

Case No	Author and reference	Sex and age	Chief clinical data	Operation	Remarks
1	E Papin Assoc franc d'Urologie, 22nd Congress, Paris, Oct 22, 1922, p 557	Female 32 years	Gradually increasing abdominal and lumbar pains Could feel isthmus and confirmed diagnosis by pyelography Both pelvis lower, with calyces directed towards midline	Ureter in front of the 2 cm isthmus on both sides Division of isthmus was easy Extraperitoneal approach	Complete relief of pain Diagnosis of horseshoe kidney made by pyelography
2	Martinow Zent f Chir , 9, 314, (Feb ) 1910	Female 49 years	Recurrent attacks of pain above level of umbilicus where could palpate tender mass	Transperitoneal division of isthmus	Complete relief of pain Diagnosis of horseshoe kidney made by palpation alone
3	Rovsing Zeit f Urol , 5, 586, 1911	Male 23 years	Recurrent attacks of girdle-like pain at level of umbilicus Disappeared when in recumbent position Could feel mass running obliquely across abdomen	Crushed isthmus by transperitoneal route	Complete relief of pain Diagnosis made by palpation alone
4	Mahnowsky Jour d'Urologie, 1, 869, (Dec ) 1912	Female 28 years	Persistent abdominal pain, accompanied by hyperacidity Could palpate isthmus	Crushed isthmus	Complete relief of pain, but not of hyperacidity Diagnosis made by palpation alone
5	Mintz Chirurg Archiv Velham, 29, 1047, 1923 Quoted by Papin Arch mal des Reins, 2, 24, Feb 1, 1925	Female 33 years	Recurrent attacks of non-localizable abdominal pain Felt mass size child's head at level of umbilicus	Transperitoneal division of isthmus	Complete relief of pain Diagnosis of horseshoe kidney not made before operation

# HORSESHOE KIDNEY

		Female, age not given	Recurrent pain, (bilateral) resembling ureteral colics	Transperitoneal division of isthmus	Complete relief of pain before Diagnosis not made before operation
6	Brongersma Zeit f Urol , 8, 477, 1914				
7	<i>Idem</i>	Male, age not given	Pain at level of umbilicus especially upon leaning forwards Hematuria after lifting heavy weight	Transperitoneal division of isthmus	Complete relief of pain Diagnosis of horseshoe kidney made at previous abdominal operation
8	Eggers Zeit f Urol Chir , 9, 427, 1922	Male 18 years	History of left-sided renal calculus, confirmed by radiography Pyelography both operation revealed both pelvis close to spine	Extraperitoneal division of isthmus with fixation of left half after pyelotomy for multiple calculi	Recovery Diagnosis made during operation
9	Kroiss Verh d Deut Gesell f Urologie, 1922	Female 29 years	Recurrent severe pain at level of umbilicus Palpable mass below this level Pyelography reveals both pelvis much lower than normal	Transperitoneal division of isthmus	Complete relief of pain Possibility of horseshoe kidney considered before operation
10	Kidd Proc Royal Soc Med , London, 15, 52, 1922	Female 32 years	Recurrent attacks of severe pain over sacral region Very mobile kidney to be felt in right iliac fossa	Transperitoneal division of isthmus	Complete relief of pain Diagnosis made during primary operation for supposed mobile kidney
11	Van Houtem Zeit f Urol Chir , 8, 165, 1922	Female 37 years	Recurrent attacks of colicky pain in back and over abdomen, accompanied by hematuria Pyelography revealed one pelvis close to spine	Transperitoneal division of isthmus	Gradual disappearance of pain Diagnosis made by palpation under anaesthesia and confirmed by pyelography before operation
12	De Groot Zeit f Urol Chir , 8, 170, 1922	Male 16 years	Recurrent severe abdominal pain which disappeared when in recumbent position Could feel mass above and to left of umbilicus	Transperitoneal division of isthmus	Complete relief of pain Diagnosis made during exploratory laparotomy

# EISENDRATH, PHIFER AND CULVER

TABLE II

## *Heminephrectomy Alone*

<i>20</i> ✓	Author and reference	Indication for operation and remarks
1	Barth (Israel) Arch Klin Chir, 74, 366, 1904	Tuberculous hydronephrosis of right half
2	Clairmont Arch Klin Chir, 79 667, 1906	Hydronephrosis in two-year-old child
3	Hoffman Wien Klin Woch, 122, 355, 1913	Tuberculosis Recovered
4	Marjasches (see Kobylinski)	Same as No 3 Died p o
5	Koenig Deut Zeit Chir, 40, 92, 1895	Sarcoma in child
6	Gibbon Rev de Chir, 1265, 1909	Same
7	Debuchy (see Kobylinski) Folia Urol 6, 160, 1911	Carcinoma
8	Rumpel Zeit Chir, 29, 1091 1902	Calculous pyonephrosis
9	Lotheissen Arch Klin Chir 52, 768, 1896	Hydronephrosis secondary to ureteral stricture Died p o
10	Paschkis Wien, Med W, 60, 2417, Oct, 1910	Calculous pyonephrosis
11	Kummell Case 2 (Flockemann) Zeit Urol Chir, 4, 204, 1918	Hydronephrosis Recovered
12	Kummell Case 4 (Flockemann), <i>Idem</i>	Calculous hydronephrosis Recovered
13	<i>Idem</i> Case 5 <i>Idem</i>	Chronic nephritis Recovered
14	Favkiss Wien Med W, 60, 1479, 1914	Tuberculosis Recovered
15	Hildebrandt Zeit f Urol, 14, 465, 1920	Sarcoma
16	Albarran Ann Mal Genitourin 25 801, 1907	Hydronephrosis Recovered
17	Leguen Necker Clinics, 1922	Tuberculosis
18	<i>Idem</i>	Echinococcus
19	Renton Brit Med Jour 1 601, May 20, 1920	Calculus with atrophic pyelonephritis
20	Leedham-Green Brit Med Jour, 2, 1583, Dec 20, 1923	Pyonephrosis
21	<i>Idem</i>	Same
22	Brvan Virg Med Month, 48, 75, May, 1921	Hydronephrosis Pyelogram (post-operative) showed median pelvis

# HORSESHOE KIDNEY

TABLE II—Continued  
*Heminephrectomy Alone*

Case No	Author and reference	Indication for operation and remarks
23	Rawling Brit Jour Surg, 9, 162, 1921	Bilateral nephrolithiasis Heminephrectomy for calculous pyonephrosis
24	Thompson ANNALS OF SURGERY, 54, 355, Sept, 1911	Pyonephrosis
25	Harris (see Thompson)	Tuberculosis
26	Rehling Int Jour Surg, 32, 239, 1919	Hydronephrosis Recovered
27	Magnus Zent f Chir	Tuberculosis Died seven weeks after operation
28	Jeck Int Jour Surg, 32, 639, 1919	Pyonephrosis
29	Judd, Braasch & Scholl J A M A, 79, 1189, Oct 7, 1922	Ureteral calculus complicated by hydronephrosis
30	<i>Idem</i>	Infected hydronephrosis
31	<i>Idem</i>	Multiple calculi
32	<i>Idem</i>	Hydronephrosis
33	Judd, Braasch & Scholl, <i>Idem</i>	Infected hydronephrosis
34	<i>Idem</i>	Infected hydronephrosis
35	<i>Idem</i>	Infected hydronephrosis
36	Oraison Gaz Hebdom, 40, 32, Feb 9, 1919	Tuberculosis
37	Nash Lancet, 174, 1151, 1908	Hydronephrosis in 16 months child
38	Bugbee & Losee Surg Gyn & Obst, 28, 97, Feb, 1919	Tuberculosis
39	Rathbun Jour Urol, 12, 612 Dec, 1924	Hydronephrosis Died 17 days p o Diagnosis made before operation by pyelography
40	<i>Idem</i>	Calculous pyonephrosis
41	Hess Jour Urol, 12, 267, 1924	Ureteral calculus complicated by pyonephrosis
42	Loeffler (Kroiss) Zeit Urol Chir, 16, 181, 1924	Infected hydronephrosis due to ureteral kink
43	<i>Idem</i>	Tuberculosis
44	W Carl Zent f Chir, 50, 506, Mar 31, 1923	Multiple calculi complicated by pyonephrosis
45	G Magnus Zent Chir, 54, 76, Jan 24, 1925	Tuberculosis Died 7 weeks p o

TABLE II—*Continued*  
*Heminephrectomy Alone*

Case No	Author and reference	Indication for operation and remarks
46	Leekahr Ky Med Jour , 21, 679, Dec , 1923	Infected hydronephrosis
47	Marson Brit Med Jour , 1, 237, Feb 10, 1923	Infected hydronephrosis complicating calculi (renal) Recovery
48	Baltscheffsky Finska Lack Handl , 64, 377, 1922	Tuberculosis Recovery
49	Israel Fol Urol , 1, 617, 1908	Hydronephrosis Diagnosis before operation by palpation
50	<i>Idem</i>	Tuberculosis Fistula persisted
51	Zondek Deut Med Woch , 46, 897, Aug 5, 1920	Calculous pyonephrosis
52	Bockenheimer Berl Kl Woch , 48, 641, Sept 4, 1911	Hydronephrosis in boy of six, due to ureteral kink
53	Simon Beitr Klin Chir , 26, 148, 1900	Sarcoma Died two days p o of anuria
54	Denk Arch Klin Chir , 116, 245, 1921	Shadows of multiple calculi close to spine at level of 3rd to 4th lumbar vertebræ Found calculous pyonephrosis of one half of horseshoe kidney and resected Isthmus at upper poles
55	Karewski Deut Med Woch , 47, 989	Infected hydronephrosis of one-half of horseshoe kidney with superior isthmus
56	Kcy Nor Med Ark , 47, 1, 1921	Hypernephroma
57	Gibbon Rev de Chir , 1265, 1909	Sarcoma Recovered
58	Desmarest J de Chir , 5, 742, 1910	Calculous hydronephrosis Recovery
59	Enderlen Presse Med , 357, 1910	Hydronephrosis Recovery
60	Marion Unpublished but cited by Botez ( <i>loc cit</i> )	Hydronephrosis Recovery
61	Michon Assoc Franc d'Urol , 15th Session, 1911	Hydronephrosis Secondary
62	Oehlecker Zeit Urol Chir , 10, 66, 1922	Hydronephrosis
63	Rovsing Zeit f Urol , 5, 586, 1911	Pyonephrosis Suspected horseshoe kidney from palpatory findings
64	Gayet Jour d'Urol	Tuberculosis Made diagnosis before operation by proximity of lower poles (palpation)

# HORSESHOE KIDNEY

## TABLE III

*Pyelotomy or Nephrotomy*

Case No	Author and reference	Technic and remarks
1	V Frisch Proc German Urol, Congress, 1911	Pyelotomy for calculus anuria Calculus passed spontaneously later Recovery
2	Steiner, <i>Idem</i>	Nephrotomy for two large calculi Recovery Suspected horseshoe kidney from palpatory findings
3	Eisendrath Surg Gyn & Obst, 15, 467, Oct, 1912	Hydronephrosis Nephrotomy
4	Israel Fol Urol, 1, 617, 1908	Diagnosis by palpation before operation Bilateral pyelotomy for calculi
5	Zuckerkandl (Paschke) Wien Med Woch, 59, 2605, Oct 30, 1909	Pyelotomy for calculus
6	Perneau (Marion) Ann Mal Gen Urin, 28 427, 1910	Pyelotomy Recovery
7	Roth (Casper) Berl Klin Woch, 48, 66, Jan 9, 1911	Nephrotomy for calculus
8	Adrian Folia Urol, 8, 189, 1913	Pyelotomy for calculus
9	Blesh Jour Okla Med Ass'n, 14, 239, Sept 21, 1921	Ureterotomy for calculus Ureter behind isthmus
10	Krotoszyner ANNALS OF SURGERY, 65, 565, 1917	Nephrotomy for calculus in case of bilateral renal calculus Died on 3rd day after operation of uremia
11	Renton Brit Med Jour, 1, 601, May 20, 1920	Nephrotomy for calculus
12	Taylor (Deaver) Am J Med Sci, 161, 238, 1921	Transperitoneal route Pyelotomy for large calculi
13	Folsom Texas St Med Jour, 16, 201, Sept, 1920	Pyelotomy for multiple small calculi
14	Leedham-Green Brit Med Jour, 2, 1583, Dec 20, 1913	Pyelotomy for calculus
15	<i>Idem</i>	Pyelotomy for calculus
16	Newman, Lancet, 2, 236, Aug 18, 1917	Diagnosis by palpation before operation Nephrotomy for calculus
17	Judd, Braasch and Scholl J A M A, 791, 189, Oct 7, 1922	Nephrotomy for calculus
18	<i>Idem</i>	Pyelotomy for calculus
19	<i>Idem</i> (Case 13)	Diagnosis made before operation from presence of shadows close to midline Bilateral pyelotomy for calculi
20	<i>Idem</i> (Case 14)	Pyelotomy for calculus



TABLE III—*Continued*  
*Pyelotomy or Nephrotomy*

Case No	Author and reference	Technic and remarks
21	<i>Idem</i> (Case 15)	Diagnosis made before operation because of proximity of shadows and of one pyelogram to spine and anterior rotation of calvces Bilateral pyelotomy for calculi
22	Judd, Braasch and Scholl Case 16, <i>Idem</i>	Pyelotomy for calculus
23	Kinard J A M A , 81, 2077, Dec 22, 1923	Pyelotomy for calculus in one-half Shadows present in opposite kidney but operation
24	Eisendrath, Culver and Phifer (Present article), Case 1	Pyelotomy for multiple calculi Diagnosis before operation from proximity of shadows to spine and pyelography
25	Eisendrath, Culver and Phifer (Present article), Case 2	Same as above Pyonephrosis of opposite half
26	Schuchardt (See Paschke) Wien Med Woch , 60, 2417, Oct 8, 1910	Nephrotomy for calculus
27	Winternitz See abstract in Zent Chir , 35, 314, 1908	Nephrotomy for multiple calculi
28	Zondek Deut Med Woch , Oct 13, 1921, See orig again	Pyelotomy for calculus Diagnosis of horse shoe kidney made before operation by presence of shadows of both kidneys close to spine
29	Voorhoeve Jour de Radiol , 3, 414, 1919	Pyelotomy for calculi Diagnosis before operation from facts that both kidney shadows were close to spine, were vertical and both lower (at same level) than normal
30	Rathbun Jour Urol , 12, 612, Dec, 1924	Pyelotomy for calculus Post-operative pyelogram confirmed diagnosis horseshoe kidney made at time of operation
31	Carlier Memoires d'Urologie, July, 1911, Masson & Co , Paris	Resection of tuberculosis upper third of one-half Recovery
32	Lange ANNALS OF SURGERY, 35, 581, 1901	Nephrotomy for calculi Recovery
33	Vince Cercle Med , Brussels, 1902	Nephrotomy for calculus
34	Walton Ann Genito-urin , 1802, 1910	Nephrotomy for calculus Recovery
35	Legueu Traite Chirurg d'Urol , 749, 1910	Pyelotomy for calculus Recovery
36	Reynard Lyon Med , 132, 151, 1923	Nephrotomy for calculus
37	Kraft Fortsch a d Geb d Roentgenstr , 29, 808, 1922	Nephrotomy for calculus Possibility of horseshoe kidney considered before operation because of proximity of shadow to spine

# HORSESHOE KIDNEY

TABLE IV

*Primary Pyelotomy or Nephrotomy and Secondary Heminephrectomy*

Case No	Author and reference	Operations and remarks
1	Gerard Ann mal gen urin , 29, 684, Apr , 1911	Pyelotomy for multiple calculi Secondary heminephrectomy for pyelonephritis Died p o
2	Kuster Cited by Kobylinski, Folia Urolog , 6, 129, 1911	Pyelotomy for hydronephrosis Secondary heminephrectomy
3	Israel Fol Urol , 1, 617, 1908	Diagnosis before operation by palpation Nephrotomy for intermittent hydronephrosis Secondary nephrectomy
4	<i>Idem</i>	Nephrotomy for hydronephrosis
5	Albarran See Kobylinski	Same as above
6	Socin Beitr Klin Chir , 4, 197, 1888	Nephrotomy for hydronephrosis Secondary heminephrectomy
7	Boeckel Jour d'Urol , 12, 296, 1921	Pyelotomy for calculi Secondary heminephrectomy for fistula due to material calculus
8	Socin (See Case 3 Table III)	Primary nephrotomy for hydronephrosis Secondary heminephrectomy Death from hemorrhage
9	Czerny-Nehrkorn Beitr Klin Chir , 31, 139, 1900	Nephrotomy for hydronephrosis Secondary nephrectomy
10	Winternitz See Steiner, Zent Chir , 28, 314, 1910	Bilat Nephrolithiasis of horseshoe kidney Nephrotomy for calculus followed by heminephrectomy on one side, nephrolithotomy on opposite side Recovery

TABLE V

*Plastics or Ureterolysis on Horseshoe Kidneys*

Case No	Author and reference	Operation and remarks
1	Gregoire Jour d'Urol , 1, 659, 1914	Mobilized kinked ureter causing hydronephrosis of half of horseshoe kidney Recovery
2	Judd, Braasch and Scholl, ( <i>loc cit</i> )	Division of isthmus with mobilization of ureter and rotation of right half in case of congenital hydronephrosis of one-half of horseshoe kidney

wards, as it approached the shadow, but did not come in close contact with it (B of Fig 14) The left opaque catheter followed a similar course, but turned inwards at a level corresponding to that of the right-sided shadow The right pyelogram† (C of Fig 14) revealed an elongated vertical pelvis close to the spine with an inferior calyx directed mesially, overlapping the disc between the third and fourth lumbar vertebrae The left pyelogram was more laterally located, but also had a mesially directed calyx

† We are indebted to Doctor Mahone, the resident genito-urinary surgeon for the painstaking manner in which the pyelograms were made in all of the cases

TABLE VI  
*Injuries of Horseshoe Kidneys*

Case No	Author and reference	Description and remarks
1	Ehler Wien Kl W , 59, 321, Feb 6, 1909	Crushing injury of abdomen Temponnade Autopsy revealed tear of isthmus
2	Brunner Beitr Klin Chir , 122, 146, 1921	Heminephrectomy for rupture of one-half of horseshoe kidney
3	Hinterstoisser Wien Klin Woch , 33, 942, Oct , 1920	Crushing injury Heminephrectomy Death
4	L Herman J A M A , 83, 17, 1924, pp 1315-1321	
5	S C Dean ANNALS OF SURGERY, 75, 253, 1922	Gunshot wound of hilus of right half Heminephrectomy Recovery

TABLE VII  
*Miscellaneous Cases*

Case No	Author and reference	Lesion and remarks
1	Moynihan Brit Med Jour , 1, 263, Feb 1, 1902	Aspirated and removed wall of cyst of isthmus
2	Pichler Mitt a d Grenz , geb , 30, 557, 1918	Made diagnosis horseshoe kidney by palpation and confirmed at autopsy
3	<i>Idem</i>	Same
4	<i>Idem</i>	Same
5	Gerster Mt Sinai Hosp Rep , 1, 214, 1899	Decapsulation for acute nephritis Recovery
6	Kuttner Berl Klin Woch , 30, 471, 1911	Exploratory for chronic hemorrhagic nephritis Diagnosis before operation by palpation
7	Sturmdorf Rev de Gyn et Chir abd , 3, 1053, 1903	Mobile horseshoe kidney Nephropexy
8	Buss Zeit Klin Med , 38, 349, 1899	Nephrectomy (through error) of entire horseshoe kidney lying in true pelvis

Both ureters entered the respective pelves in a peculiar manner, passing behind the shadows of the mesially directed calyces. From the above findings a diagnosis of horseshoe kidney was made and confirmed at operation. It was necessary to extend the usual lumbar kidney incision forwards so that the anterior surface of the renal pelvis could be exposed after displacement inwards of the peritoneum. The upper pole was at the level of the costal arch and one could follow an isthmus of about 4 cm width inwards until it crossed the spine. Through an incision in the anterior aspect of the renal pelvis, much phosphatic detritus and two well-formed but soft calculi were removed. No attempt was made to close the pyelotomy incision. The convalescence was uneventful.

## HORSESHOE KIDNEY

CASE II—*Pyelotomy for renal calculus in one-half of horseshoe kidney Presence of this anomaly diagnosed before operation*

Male, aged fifty-one, with history of fistula following drainage of right perinephric abscess ten months before. There was marked pyuria and absence of dye excretion from this right kidney, but clear urine and prompt concentrated dye output on the left side. Radiographs (Dr Cora M Matthews) revealed a series of four oval shadows (A of Fig 15) on the left side and close to the spine. They were directed downwards and inwards, so that the lowermost one was in contact with the outer end of the left transverse process of the fourth lumbar vertebra. The intra-renal character of these shadows was confirmed by the relation of the opaque catheter and by pyelography (B of Fig 15). The former curved sharply inwards and at its upper end was in close contact with the lowermost of the calculous shadows. The opaque medium included all of the shadows and revealed a narrow vertical pelvis, with the upper calyx directed medially. From these findings alone a diagnosis of calculi in the left half of a horseshoe kidney was made. In order, however, to more accurately ascertain the condition of the right half, a pyelogram was made and revealed (C of Fig 15) an advanced degree of dilatation of the renal pelvis, thus confirming our findings on ureteral catheterization. Before a right heminephrectomy could be considered it was deemed advisable to remove the calculi from the left half.

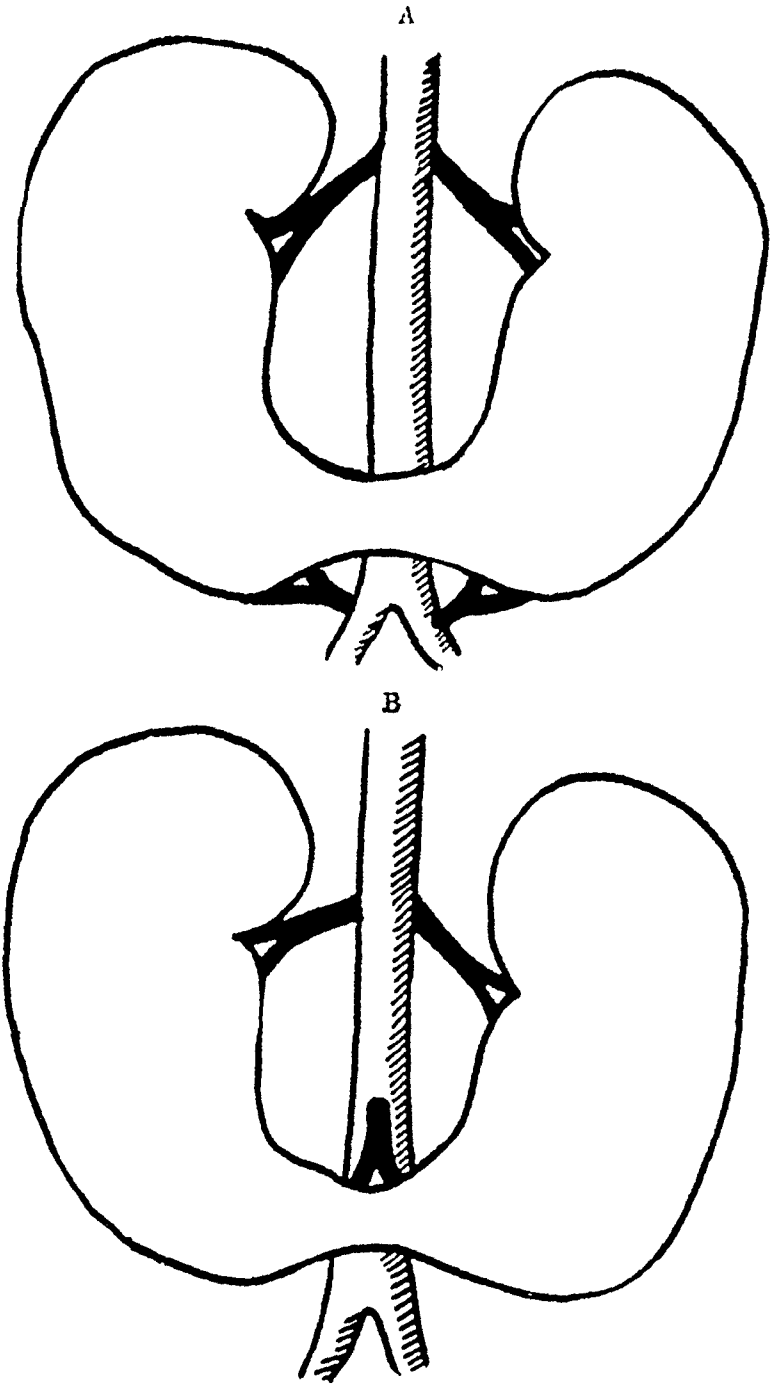


FIG. 13. A and B—Most frequent types of blood-vessels (Papin). A Single vessel to each half and two to isthmus. B Single vessel to each half and one to isthmus.

On June 17, 1925, the left renal pelvis was exposed extraperitoneally, on its anterior aspect. The upper pole of this half of the horseshoe kidney was, as in the first case, at the level of the costal arch and the lower pole was continuous with an isthmus which measured 3 to 4 cm in a vertical direction. The ureter, as in the first case, passed across the front of the isthmus and like the pelvis, showed marked thickening of its walls. No difficulty was experienced in the delivery of four calculi through an incision in the anterior aspect of the renal pelvis. The convalescence from this operation was unevent-

ful and an attempt will be made in the near future to remove the pyonephrotic right half (C of Fig 15)

CASE III—*Tuberculosis of one-half of a horseshoe kidney* Presence of this anomaly diagnosed by pyelography but not yet confirmed at operation

Male, aged twenty-four Sudden onset of severe pain over right kidney region of one

week's duration Frequency of urination especially during the day for a longer period There was considerable tenderness over the right kidney One brother had kidney removed for tuberculosis Bladder urine very turbid, as was also that from the left kidney Discretion from this side was delayed and poor as compared with the opposite (right) side Acid-fast bacilli were found by Doctor Connell, the intern in charge in the bladder urine, but they could not be found in the urine from the left kidney Radiography (Dr Corr M Matthews) revealed nothing abnormal in the plain film, *i.e.*, before the opaque catheters were passed The film taken after these (opaque catheters) were introduced and the opaque median (12 per cent sodium iodid) injected on both sides revealed the following very interesting findings (Fig 16)

1 The opaque catheters on both sides curve outwards as they reach the lower border of the fourth lumbar vertebra This is more marked on the left side

2 The right pyelogram has an unusual contour At its upper end one observes superior and middle calyces which are approximately normal in location but unusual

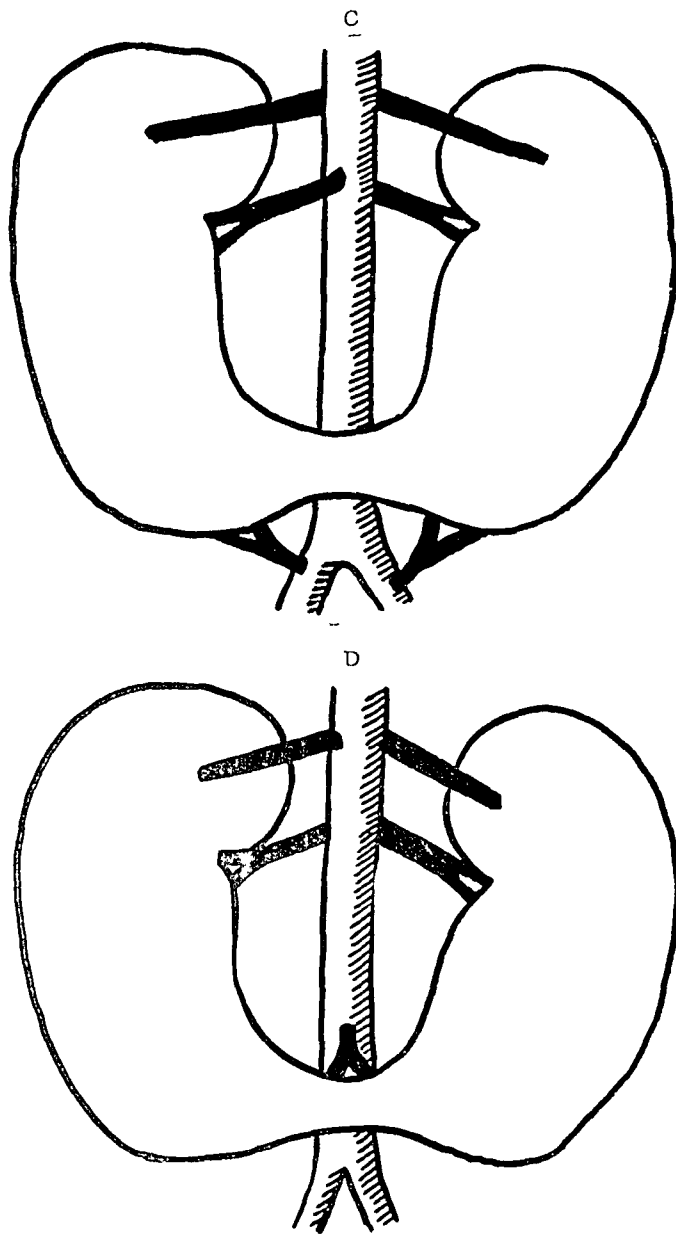


FIG. 13 C and D—Most frequent types of blood-vessels (Papin)  
C Two vessels to each half and two to isthmus D Two vessels to each half and one to isthmus

in arising from an expanded area of the pelvis instead of a tapering portion as is to be seen in the normal pelvis There is a rudimentary inferior calyx directed laterally

The most striking feature, however, of this right pyelogram is seen at its lower end Here one notes the extension mesially of the pelvis proper, so that it completely covers the corresponding transverse process of the third lumbar vertebra This portion of the pelvis is almost quadrilateral in form and has rudimentary calyces along its mesial and

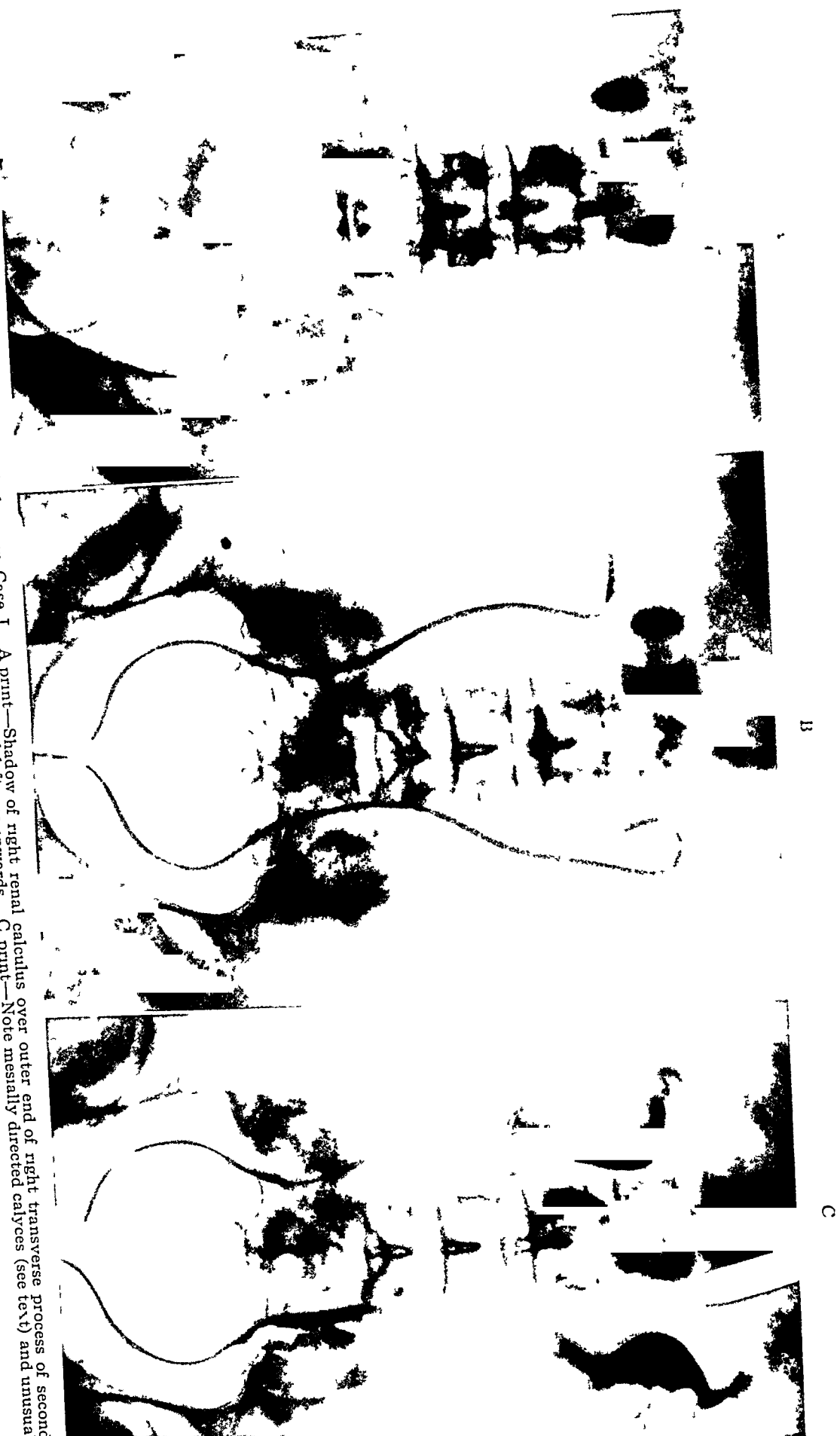


Fig 14—Radiographic and pyelographic findings in Case I A print—Shadow of right renal calculus over outer end of right transverse process of second lumbar vertebra B print—Note how right opaque catheter turns outward and left one inwards C print—Note mesially directed calyces (see text) and unusual forms of both pyelograms, also close proximity of right one to spine

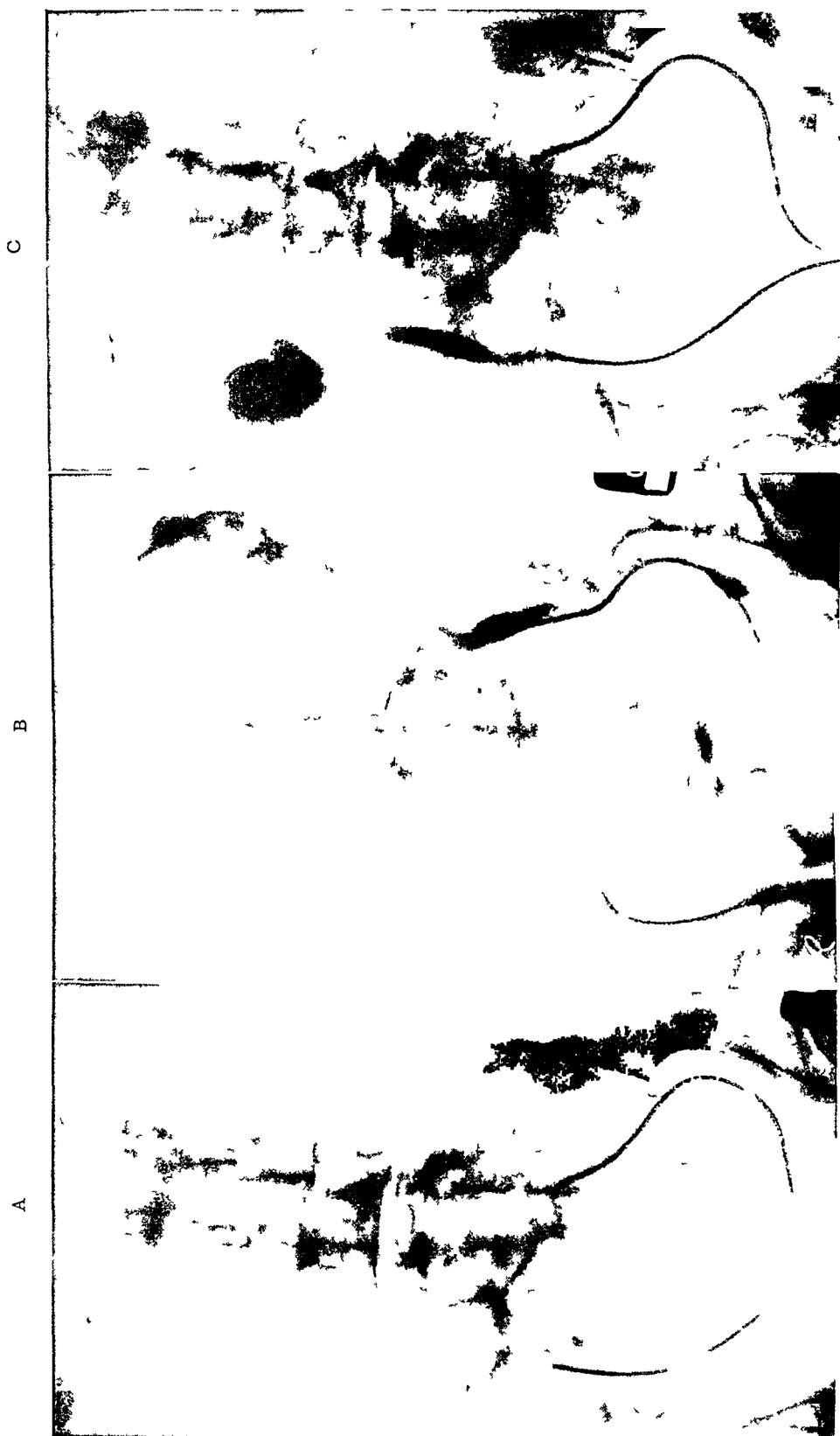


FIG. 15.—Radiographic and pyelographic findings in Case II. A Shadows of the four calculi arranged in serial manner obliquely opposite fourth lumbar vertebra. B Pyelogram including shadows seen in A with several calyces directed mesially. Note peculiar shape of this pelvis. C Pyelogram of right half showing marked dilatation of pelvis and calyces (infected hydronephrosis).

## HORSESHOE KIDNEY

caudal borders. A diagnosis of horseshoe kidney could be made from such a pyelogram alone.

3 The right ureter runs behind the inferior calyx and enters the pelvis along the middle of its curving caudal (inferior) border.

4 The left pyelogram also reveals some features which are characteristic of horse-



FIG. 16 —Pyelographic findings in Case III. Note mesially directed calyces on both sides, also how right pelvis extends across front of body of third lumbar vertebra. Note unusual form of both pelves.

shoe kidney, due to faulty rotation. The pyelogram is situated at about the distance from the spine which is found under normal conditions. The pelvis itself has a peculiar form, there being a marked protrusion along the mesial border at the upper inner angle. The superior, middle and inferior major calyces are very short and the ureter as on the



right side runs behind the inferior major calyx to enter the pelvis along the middle of its caudal (inferior) border, instead of its mesial as in the normal kidney

A more significant finding is that one of the calyces is directed mesially, an almost pathognomonic evidence of renal torsion, as Braasch has pointed out

From our pyelographic evidence we feel confident that we are dealing with a tuberculosis of one-half of a horseshoe kidney, but the patient having thus far refused operation, we must postpone confirmation of our diagnosis for the present

#### RESUMÉ OF ALL PUBLISHED CASES AND OUR OWN

I Clinical Pictures—Aside from the syndrome first described by Rovsing<sup>14</sup> there are no pathognomonic symptoms indicative of this anomaly

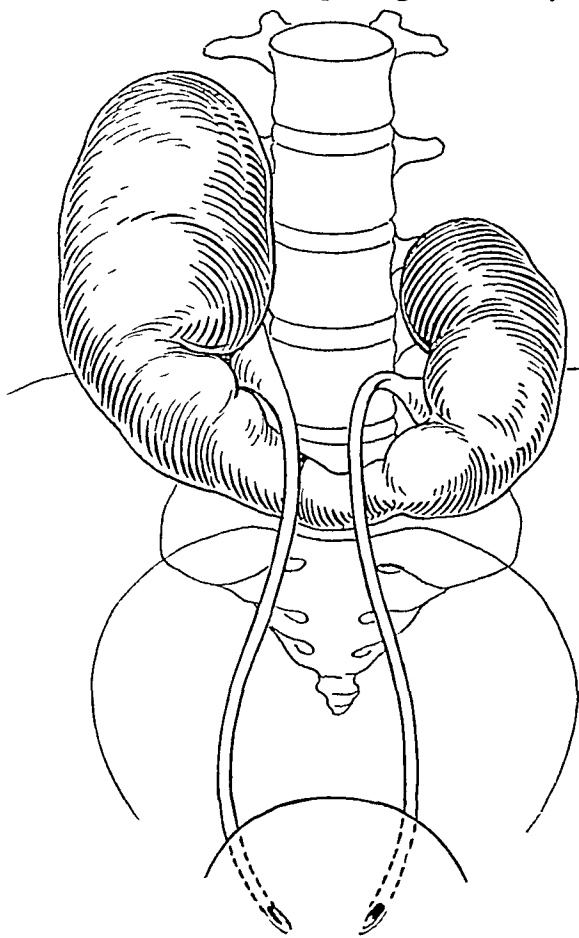


FIG. 17—Hydronephrosis of right half of horseshoe kidney (Bockenheimer)

In the cases first reported by Rovsing and since by others (see Table I), the abdominal pains are thought to be due to pressure of the isthmus on the large vessels behind it (aorta and vena cava) and accompanying them. The complete relief of symptoms after division of the isthmus (symphysiotomy) lends support to this compression theory. The pain in these cases is referred to both lumbar regions and is vaguely localized in different parts of the abdomen. The most characteristic feature is the increased degree of pain on leaning forwards or upon exertion, and its complete disappearance on lying down. Neufville<sup>15</sup> described an unusual case related to this syndrome of Rovsing. A young man of twenty-five had edema of both lower limbs and a slight degree of ascites for a

brief period. At autopsy the vena cava was found thrombosed by the compression of a vena cava. We quote this case with skepticism as to the relation of the anomaly to the thrombosis.

In Table IX we have grouped the entire 132 cases, including our own, as to the frequency of the various lesions and would direct attention to the fact that the majority are the result of the conditions mentioned above as being present in horseshoe kidney and favoring stagnation. For this reason, diseases such as calculi, hydronephrosis and pyonephrosis etc. constitute the majority

# HORSESHOE KIDNEY

2 Diagnosis —(Compare with Table VIII) In the earlier cases, the proportions which were diagnosed by palpation alone is far greater than since the advent of radiography supplemented by pyelography. Of a total of 133 cases (including our first two) only 19, or 14.2 per cent., were diagnosed before operation or autopsy and confirmed. From the modern urologic standpoint we can eliminate the ten cases (all except Van Houten in the first

TABLE VIII<sup>1</sup>  
*Cases Diagnosed before Operation or Autopsy<sup>2</sup>*

Palpation or plus pyelography	By proximity renal shadows to spine	By proximity calculus shadows to spine	By pyelography alone	Proximity calculus shadows to spine	Suspected before operation
Martinov, I-2	Zondek III-28	Judd, Bransch and Scholl III-19	Papin I-1	Judd Bransch and Scholl III-21	Kross I-6
Rovsing I-3	Voorhoeve, III-19		Rathbun II-39	Fisendrath Phifer and Culver III-23; idem, III-25	Rovsing I-13
Malinovsky I-4					Stinner III-2
Van Houten (3) I-11					Israel III-4
Israel IV-3					
Pichler, (2) VII-2					
Pichler, (2) VII-3					
Pichler, (2) VII-4					
Newman III-16					
Israel, II-49					
Kuttner, VII-6					
Totals 11	2	1	2	3	4

1 Figures after author's name refer to Table and Case number respectively

2 Pichler's cases were not operated but confirmed at autopsy

3 In this case diagnosis made by palpation and confirmed by pyelography

TABLE IX  
*Frequency of Various Lesions*

Table No	Pain	Hydronephrosis	Calculi	Tuberculosis	Pyonephrosis	Others
1	11		1			
2		23	13	13	6	9
3		1	34		1	
4		7	3			
5		2				
6						4
7		1				3
Totals	11	34	51	13	7	16

column of Table VIII) in which diagnosis was made by palpation alone because this would hardly be depended upon at the present time. One can also discard the four cases not included in the nineteen (Table VIII) in which the diagnosis was only suspected, thus leaving nine cases in which more recent methods of diagnosis ‡ were employed. From an analysis of these nine cases we can cite the following as important radiographic features

‡ Radiography (plain) supplemented by employment of opaque catheter and pyelography

(a) The close proximity of one or both renal shadows to the spine at a lower level than normal

(b) The close proximity to (Fig 14) or obliquity of position (Fig 15) in relation to the spine, of the shadows of renal calculi. If one or both halves of the horseshoe kidney lie close to the spine the value of (a) and (b) as diag-

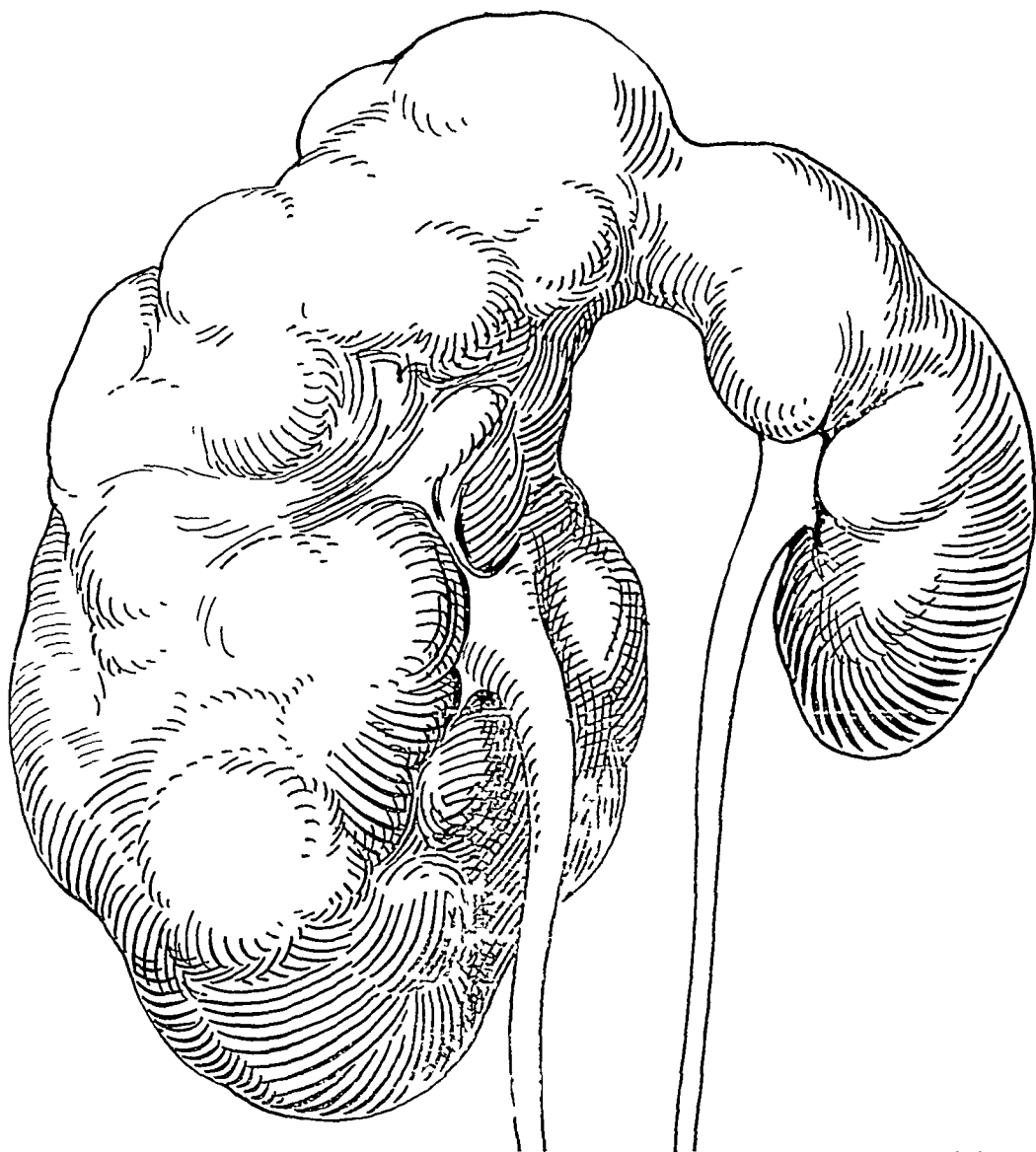


FIG 18 —Hydronephrosis of right half of horseshoe kidney with superior isthmus (Karewski)

nostic features cannot be underestimated. If, however, one or both halves are symmetric (Fig 1), *ic*, at the same level and as far away from the spine as is the normal kidney, the above data are of little value alone. One must also recall the possibility of renal or calculous shadows being at different levels (Fig 2) in an asymmetric horseshoe kidney.

(c) Urography —This in our opinion is the method which corroborates the suspicions raised by the findings cited under (a) and (b). If one or both pyelograms (Figs 14, 15 and 16) lie in close proximity to the spine at

## HORSESHOE KIDNEY

the same or different levels, or even extend partly across the spine (Fig. 6), as in one of our own and in Rathbun's case, there can be little doubt as to the presence of horseshoe kidney. The same is true even if one pyelogram is close to the spine and the opposite one at the normal distance. (Fig. 14.) If, however, both pyelograms are not close to the spine one must depend on other findings which are of great value not only under these conditions of normal distance of pyelograms from the spine, but also when one or both are in close proximity.

These additional data were first called to our attention by Blaasch. They are due to the faulty rotation of the halves of a horseshoe kidney. As a result we find (a) one or more calyces directed mesially (Fig. 14), (b) very long, narrow pelvis (Fig. 15) or "bizarre" shapes, (c) unusual course of the ureter, *i. e.*, passing behind a calyx (Fig. 14) and not entering the pelvis along its convex border (Fig. 14).

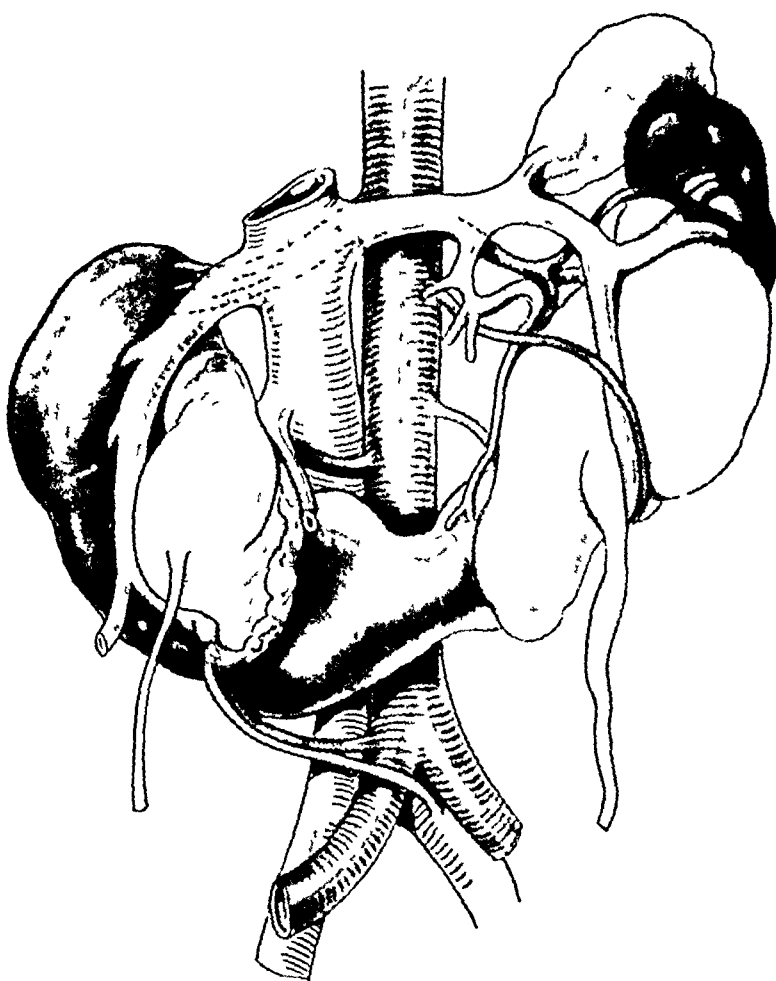


FIG. 19—Hydronephrosis of both halves of a horseshoe kidney (Papin)

We believe that more widespread knowledge of these radiographic features will enable us to make a pre-operative diagnosis in the future in a larger percentage of cases.

### TYPES OF OPERATIONS PERFORMED ¶

Table I	Symphysiotomy (Division of isthmus), alone or combined with other operations, such as fixation of left half after pyelotomy for calculi (Egger's case)	
Table II	Heminephrectomy alone	12 cases
Table III	Pyelotomy or nephrotomy	63 cases
Table IV	Primary pyelotomy or nephrotomy and secondary heminephrectomy	35 cases
Table V	Plastics or ureterolysis	10 cases
Table VI	Subparietal injuries	2 cases
Table VII	Miscellaneous, not including three cases of Pichler (not operated)	4 cases
		5 cases
Total		131 cases

¶ Owing to omission of mention of result of operation in a sufficiently large number to nullify the value of any deductions, the percentages of deaths and recoveries will be omitted.

*Technic of Operations on Horseshoe Kidneys*—The method of approach should always be by the extraperitoneal route employing the same incision (lumbar) as in the normally placed and formed kidney. It is necessary, how-

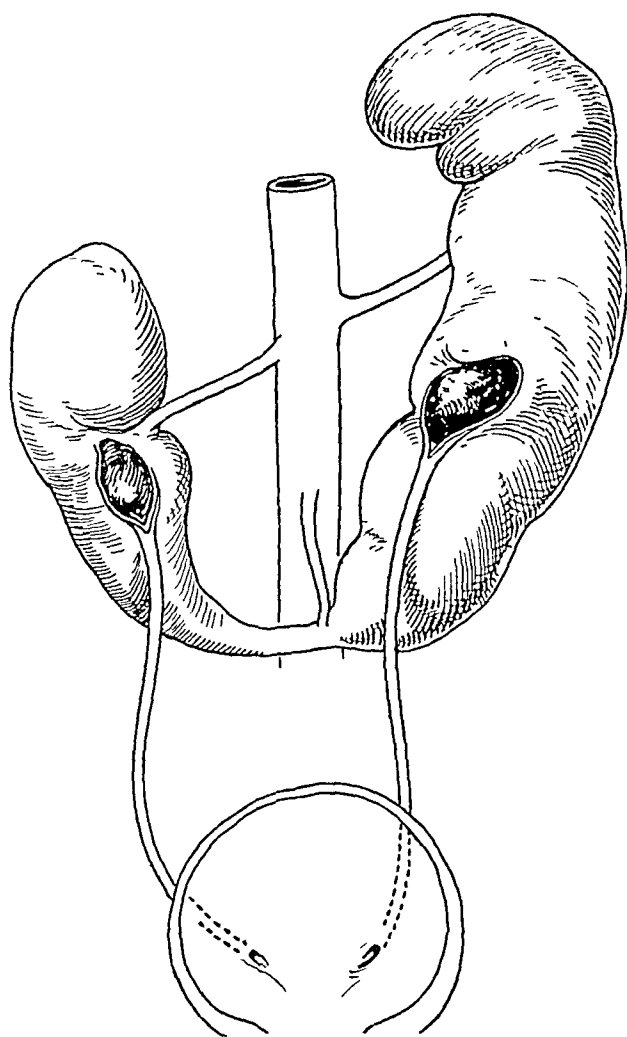


FIG. 20.—Bilateral calculi in horseshoe kidney (Schuchardt)

ever, to extend the incision much nearer the outer border of the corresponding rectus muscle because access to the pelvis must be from the ventral and not from the dorsal aspect as in ordinary (posterior) pyelotomy. There is usually no difficulty in displacing the peritoneum while the patient is in the lateral position and then changing to a supine position while the pelvis and isthmus are being exposed. We found that this change of position of the patient after division of the various layers of the abdominal wall and strong retraction of the peritoneum enabled us to work under guidance of the eye in both cases. For heminephrectomy a similar good exposure is essential owing to the many accessory vessels (both arteries and veins) which enter the hilus, poles and isthmus in a very irregular manner. The

isthmus can be clamped as one proceeds to divide it and the denuded areas closed by mattress sutures of chromic gut reinforced at loop and knot by fat pads.

## NON-PARASITIC CHYLURIA<sup>1</sup>

By ADOLPH A. KUTZMANN, M.D.

OF LOS ANGELES, CAL.

FROM THE DEPARTMENT OF UROLOGY, UNIVERSITY OF CALIFORNIA, SAN FRANCISCO

NON-PARASITIC chyluria is of infrequent occurrence on the American continent. The literature is chiefly European, especially German, few American writers having called attention to this curious clinical occurrence. Very little is known of the true causes underlying non-parasitic chyluria, and therefore it is essential that all cases be recorded. The presence of such a case on the University of California Urological Service of the San Francisco Hospital prompts the following report.

G. D., colored single, twenty-one years of age, entered the hospital with the complaint of "cloudy urine." The family history was irrelevant.

The patient was born in South Carolina where he lived until the age of twenty years. During the last year he has been in California. His occupation has been various—cook's helper, boot-black and farm hand. He had measles and mumps as a child, no history of other illnesses. He has had five attacks of gonorrhea in as many years, the last being two months ago, acute epididymitis and right inguinal bubo one year ago. Primary denied. Habits good. No history of any accidents. Inguinal bubo drained one year ago.

The present illness began three years ago, at which time he noticed that the urine was milky in color. Since then it has been intermittent, bearing no relation to diet, work, etc. Two months ago patient thought that some blood was present in the urine. During the last two months there has been a dull lumbar pain, especially on the left side. The remainder of the history is irrelevant except that the patient was still being treated for his last venereal infection.

The physical examination showed a well developed and nourished negro, in no apparent distress. General examination was negative. Blood-pressure 120/80. *Genitalia*. Slight urethral discharge, smear negative for Gram-negative intracellular diplococci. Prostatic massage 10 per cent pus, normal amount of lecithin, many motile sperm.

*Laboratory Data*—Blood. Hemoglobin 80 per cent, red blood cells 4,670,000, white blood cells 8800, polymorphonuclears 71 per cent, lymphocytes 27 per cent, transitionals 1 per cent, eosinophiles 1 per cent. Examination of blood during night and day revealed no filariae.

*Urine* (voided specimen). Clear, amber, specific gravity 1.016, sugar negative, albumin negative. Micro—Red blood cells rare, white blood cells rare, casts, none, epith rare. Examination negative for filarial parasites.

*Blood Wassermann*. Negative.

*Phthalein* (intramuscular). 1st hour, 50 per cent, 2nd hour 25 per cent, total 75 per cent.

X-ray. Kidneys, ureters and bladder essentially negative.

*Cystoscopic Examination*—Cystoscope F 26 easily inserted. No residual urine. Bladder capacity—350 c.c. Bladder wall showed mild diffuse cystitis, otherwise negative for stone, tumor, ulcer, etc. Left ureteral orifice reddened and edematous. Right orifice negative. Trigone markedly reddened and revealing some bullous edema, espec-

---

<sup>1</sup> Read in brief before the California Medical Association, May 18, 1925.

ially on the lower half and extending on to the vesical neck. Both ureters easily catheterized to kidneys. The left ureteral catheter immediately began to drain milky fluid with a pinkish tinge. The bladder urine had been clear.

	Right	Left	Transvesical
Size of catheter	F 6	F 6	
Flow	Normal	Normal	
Macroscopic	Clear	Milky	Clear
R B C	Numerous	Numerous	None
W B C	None	2-3 h d f	2-3 h d f
Epith	1-2 h d f	2-3 h d f	2-3 h d f
Casts	None	None	None
Organisms	None seen	None seen	None seen

*Phthalein* (intravenous)

Appearance time	2 minutes	2½ minutes
1st 15 minutes	20%	17%
2nd 15 minutes	10%	4%
Total	30%	21%

Bladder leakage—none

*Cultures*—*B. coli* in left kidney and bladder specimens. Right kidney sterile. All acid-fast stains negative.

The urine from the left kidney could not be centrifuged clear and microscopically showed no morphology except an occasional pus cell and many cell blood cells. The specimen was immediately suspected as being that of a chyluria. The milky color cleared almost entirely upon shaking with ether; the residue of an evaporated ether extract stained readily with Sudan III. Upon standing a rather firm, pinkish clot would form in the urine. This urine was positive for albumin, while the clear specimens had been negative. No parasites were found.

A pyelogram of the left kidney appeared normal except for a slight haziness about the upper calyx (Fig 1). Right pyelogram was negative. The lumbar backache was not reproduced with either pyelogram.

*Course*—With the finding of no parasites in either the blood or the urine, the case was considered as a chyluria non-parasitic in type, and left renal in origin. No significance was placed in the slight finding of the upper left calyx as shown in the pyelogram. The urine continued to be intermittently cloudy, occurring four to five times weekly and usually in the morning. The presence or absence of fat in the diet did not seem to influence its occurrence.

The patient received three pelvic lavages of the left kidney within a period of fourteen days using each time 3 cc of 1 per cent silver nitrate. The chyluria disappeared after the third lavage. This was followed by a rise in temperature to 100° F, which subsided in four days. During this time the patient continued to have a dull, non-radiating pain in the left flank. Two days later the temperature again rose, reaching a peak of 103° F on the third day. Cystoscopy with catheterization of the left kidney revealed nothing, however, examination of the chest gave sufficient evidence to make a diagnosis of mild bronchopneumonia. This cleared up entirely in eight days. The temperature continued more or less normal, but the slight dull pain in the left flank persisted. The urine was clear at all times. Examination by careful palpation now revealed some spasticity of the lumbar muscles and a vague feeling of a mass.

A complete urological examination was again performed. The left pyelogram on first injection now showed a cavity 1½ x 3 cm in size irregular in outline and lying out under the eleventh rib (Fig 2). Further injection with the ureteral catheter pulled down demonstrated the left kidney pelvis and ureter, the lower calyces being normal, while the upper ones appeared somewhat deformed by pressure from without. It was

## NON-PARASITIC CHYLURIA

therefore concluded that there was present a large perineal abscess at the upper pole which might communicate through the upper major calyx (Fig 2)

Operation revealed the following The lumbar muscles and fascias were very dense and fibrotic A large abscess cavity was opened into and about 150-200 cc of dark brown pus and necrotic material evacuated This had been preceded by a gush of about 50 cc of urine-like fluid Culture of the abscess gave *B coli* Examination of the abscess cavity showed it to be the size of one's fist, intimately associated with the upper and middle parts of the kidney and extending anteriorly to the peritoneum The abscess was found to communicate with the kidney through a small sinus-like aperture on the posterior aspect of the upper pole Further examination could not be carried out because of the dense inflammatory adhesions everywhere No definite cause could be established for the chyluria An intracapsular nephrectomy was performed, the cavity thoroughly irrigated with 1-1000 mercurochrome, and the usual closure with drainage made Uneventful convalescence, the wound healing by primary union, except posteriorly where drainage had been instituted The patient, seen two months after the operation, was in good health and the urine was clear



FIG 1—Pyelogram of left kidney six weeks prior to operation There is a slight haziness about the upper calyx

*Gross Pathology*—The specimen

consists of a kidney measuring  $8 \times 6 \times 3\frac{1}{2}$  cm The external surface has adherent large masses of blood and necrotic tissue The surface of the kidney is dull with flakes of fibrin attached No capsule can be found The cut surface shows fairly normal appearance, except that in the vicinity of the sinus above mentioned the tissue is dull and compact Just below the convex border and on the posterior aspect is a small sinus communicating with the posterior minor calyx of the upper major calyx Sinus blocked with necrotic tissue (Fig 3)

*Microscopic Pathology*—Microscopic sections show numerous glomeruli, varying in size from large to small The latter are atrophic in appearance Bowman's capsule has disappeared in some places, so that the glomerulus can hardly be seen The tubules are often dilated Cloudy swelling is marked in most areas There is a very diffuse moderate lymphoid cell infiltration

An irregular cavity is seen in one section It has a ragged lining of connective tissue, heavily infiltrated with lymphocytes, plasma cells, endothelial cells laden with blood pigment and occasional eosinophiles (This section was taken through the sinus connecting with the abscess)



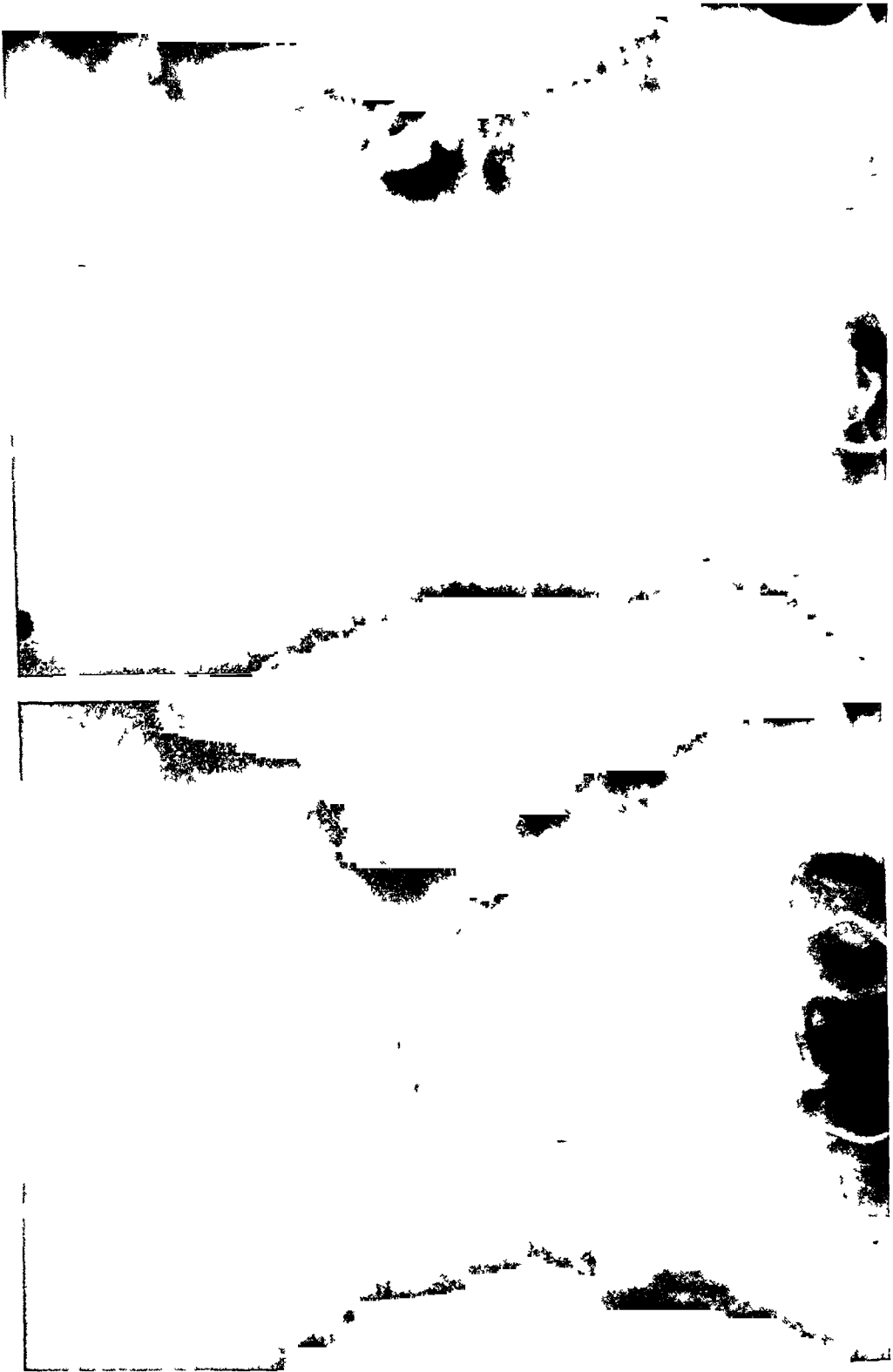


Fig. 2.—Pyelograms of left kidney just before operation. The first shows the perirenal abscess injected, the second pyelogram was taken immediately afterward with the ureteral catheter drawn down. Note the relation of the abscess to the kidney pelvis and the deformity produced in the upper calyces.

## NON-PARASITIC CHYLURIA

A layer of connective tissue, moderately infiltrated with mononuclear cells lies external to the cortex and is the abscess wall (Figs 4 and 5)

*Diagnosis*—Perinephritic abscess with chronic diffuse nephritis Communicating sinus between abscess and kidney pelvis

The case was considered as being one of non-parasitic chyluria because of the characteristics presented by the urine and the absence of parasites The duration was over a period of three years and yet the patient was not incapacitated in any way The co-existence of the perinephritic abscess and its communication with the kidney pelvis probably had no relation to this patient's chyluria It is not likely that the abscess had been present for three years and yet not given rise to more symptoms The history of lumbar pain over a period of two months probably indicates the existence of the abscess

Detailed fat studies were not carried out because of the lack of facilities The case presents many similarities to others reported in the literature, namely, periodicity as to occurrence intermittently and time of day Various authors have found that chyluria was present in the night or morning urines and cleared as the patient became more active during the day The various characteristics, such as the pinkish milky color, absence of morphological characteristics microscopically except for red and white blood cells, failure to centrifuge clear, even at a high rate of speed, clearing with ether, prove this to be a case of chyluria The failure to find filariæ in the blood and urine, places it in the non-parasitic group



FIG 3—Photograph of left kidney in longitudinal section The stick (A) marks the path of the communicating sinus between the perinephritic abscess and the upper calyx of the kidney pelvis The tissue attached to the upper pole is part of the abscess wall and kidney capsule

*Historical Note and Discussion*—The recognition of fat in its various forms as occurring in the urine is no new one The mention of fatty and oily urines has been found in the ancient writings of Hippocrates, Galen and Theophile (Sanes and Kahn) Its significance was variously interpreted as approaching delirium, convulsions, death or the excretion of milk in the



FIG 4 —Photomicrographs (low power) showing some cloudy swelling of the convoluted tubules and sclerosis of the blood-vessel walls. In the medullary part of the parenchyma there appears to be some dilatation and decrease of the collecting tubules with a corresponding increase of edematous interstitial tissue

## NON-PARASITIC CHYLURIA

urine The writers of the middle ages added but very little Actuarius (thirteenth and fourteenth centuries), Gordon (fourteenth century) and others ascribed it as a symptom of hectic fever, phthisis and a very grave indication of impending death In 1670, Moellenbroccius designated the condition as chyle in the urine and called it "mictio chylosa" This trend nearer to the truth had probably been brought about by the discovery of the lymph circulation by Pecquet in 1651 Stalpart van der Wiel (1687) wrote an extensive treatise at this time, citing Florentinus, who mentions probably the first case occurring in a child (thirteen-year-old boy) He concluded that the substance was chyle and based his theory on the bladder lymphatics described by Bartholinus and that the milky urine was due to a compression of the bladder channels (*vasa lactea*) Peu in 1694 found a chyluria occurring in a parturient woman and ascribed it as a means of eliminating excessive milk fat Morgagni in his discussion felt it to be of renal origin There followed



FIG. 5.—Photomicrograph (low power) through wall of communicating sinus showing marked fibrosis and round cell infiltration

but few studies, those of Stoller (1777), J. P. Frank (1794) and Vogel (1807) Stoller was the first to use the terms, "diabetes lacteus," "chylarius" and "coeliacus urinalis" and differentiated them from phosphaturia and pyuria Frank's case was that of a chylous diabetes Alibert and Cabelle (1817) designated the condition as "urine laiteuse" Many excellent studies and observations followed—Prout (1835), Rayer (1838), Golding-Bird (1843), Bramwell (1858), Beale (1861), Bence-Jones (1862), Roberts (1872), Oehme (1874—first autopsy in a non-parasitic case), Goetze (1877), Glazier (1877), Haddon (1879), Vogelius (1879—associated with pernicious anaemia), Brieger (1880), Concatto and Guareschi (1881) and many others Probably the best studies of non-parasitic chyluria have been those of Senator (1883 and 1894), Franz and Stejskall (1903) and Magnus-Levy (1908)

Goebel (1921) has written a good discourse of its rare occurrence in children. These do not include the host of workers on the parasitic chyluria, in these, Wucherer (1869), the first to demonstrate filaria in parasitic chyluria, Manson, discoverer of the filarial parasite, Mackenzie, Carter, Waters, Low and many others are worthy of mention. From time to time lengthy discussions have appeared as to etiology of non-parasitic chyluria, but they differ very little to-day from those of the earlier writers.

*Etiology*—Chyluria may be divided into two types (1) Parasitic or tropical group, (2) non-parasitic or non-tropical group. A third group, called functional chyluria (Sanes and Kahn, Marion) can well be placed in the second group. In the parasitic type the filaria sanguinis hominis is the chief causative agent, although chyluria has been mentioned with taenia nana (Piedtetschensky), eustrongylus gigas (Stuehr), cercomonas hominis (Rosenheck and Rodhenburg), malaria (Quarelli), etc. Wucherer, in 1869, showed the filaria to be present in patients with parasitic chyluria (Welfeld). It is, however, the mechanism that has given difficulty. In the non-parasitic chyluria, both the etiologic and mechanical factors are upon a theoretical basis.

Since the discovery of the lymph circulation by Pecquet in 1651, the mechanism and point of entry into the urinary tract has been sought for. Prout and Rayet brought forth the theory that chylous urine was separated from the blood and that there were no abnormal communications between the lymph system and the urinary tract. To support this, they assumed a chylous blood condition—"chylose blutbeschaffenheit"—with a lowered threshold of substance exchange and thereby leading to a pathological filtering through the kidney. This theory later found supporters in Eggel, Thudichum, Brieger, Virchow, Goetze, Cohnheim, Wolff, Waldvogel und Bickel. This theory has gradually lost ground until it has very few if any adherents.

The second and more feasible theory has been that of lymphatic obstruction and abnormal communication with the urinary tract for the chyle to enter. This was first brought forth by Carter in 1862, reporting two cases of filariasis with lymph scrotum. It was assumed that the filaria obstructed the lymph flow, caused inflammatory changes and ruptured into the urinary tract. Tropical chyluria has lent itself well to explanation on this basis. The work of Mackenzie and the substantiating evidence by Manson have given strength to this theory. Numerous workers—Dickinson, Havelburg, Siegmund Myers, Grimm, Vieillard, Feuerstein and Panek, Slosse, Piedtetschensky, Magnus-Levy, Port and others—have adhered to this theory. It is the one most universally used at present to explain chyluria. We therefore have to assume an anatomical lesion of the lymphatics (Carter) rather than a constitutional anomaly (chylose blutbeschaffenheit). Evidence, much of it questionable, has been offered from time to time to strengthen the theory and to determine the point of entry into the urinary tract. Cases of non-parasitic chyluria have come to autopsy and revealed no information (Oehme, Roberts and Heitz). Port's case showed large caseous mediastinal glands obstructing

## NON-PARASITIC CHYLURIA

the thoracic duct, but no point of entry into the urinary tract. Havelburg at autopsy found a large multilocular dilated lymph sac extending from the left kidney to the bladder, where its attachment was sieve-like and thereby allowed the chyle to pass through. Ponfick's case was similar, but there was some skepticism about such portal of entry (Vinchow). Ludke thought his case to have a point of entry in the bladder. To further substantiate that chyluria is due to blockage in the lymph system, Magnus-Levy cited an eleven-year-old girl who had a swelling on the left hip which later led to the exuding of chyle. Fifteen years later a chyluria resulted and the chyle fistula disappeared.

Pope demonstrated by cystoscopy a chyle sinus on the bladder trigone. In connection with this, the case of Bloch is of significance. A girl seventeen years old had chyluria, especially in the morning, of several years' duration. Cystoscopy revealed a white dome-like structure just above the right ureter. On the medial aspect was seen a small opening from which came forth a strong stream of chyle. The cyst was destroyed and thoroughly cauterized. The chyluria ceased immediately. The patient was followed for a period of days and the urine remained clear. Cystoscopy has been a great aid in location of the chyluric source. Cases are reported as either being unilateral or bilateral or vesical in origin.

The route between the intestinal and renal lymphatics has been of much speculation. According to Magnus-Levy, the chyle must first go from the mesenteric lymph channels through the mesenteric lymph glands to the thoracic duct. Thence, because of obstruction, there is a retrograde flow to the upper lumbar lymph-glands which drain the renal lymphatics. To obtain such a retrograde flow, an insufficiency of the valvular system of the lymphatic channels must be assumed. Hampton has likened the renal lymphatics to the cerebral arterial vessels as points of lowered resistance. Assuming a lymphatic block in that system there may then occur a leakage of chyle through the kidney just as a cerebral hemorrhage due to hypertension. These points are all hypothetical. Possibly with a bettering of pathologic studies in the future, these points may well be proven and demonstrated. According to the researches of Stahr and Kunita, the lymph channels of the fibrous and fatty capsules, communicating with the lymph channels in the renal cortex, can be injected from the capillary bed of the muscularis of the small intestine (Quincke).

Goebel states that to have a chyluria, two conditions must be fulfilled (1) The lymph channels must open into the urinary tract, and (2) the lymph channels through recurrent channels must empty their contents into these lymph channels of the urinary tract. Where only the first condition is fulfilled, there ensues a "lymphuria without chyle" and where both conditions are fulfilled, chyluria results. He further adds that it is known that there are connections between the lymph channels of the adventitia and muscularis of the ureter and bladder with the lymph channels of the intestinal mucosa and at the other end with the hypogastric and lumbar lymph channels. If, therefore, an opening occurs between the lymph channels of the mucosa and

the lumen of the urinary tract, a "lymphuria" occurs, recognized by the albumin content of the urine. Furthermore there must not be a continuous stream of lymph through the existing communication, but it must occur only under particular pressure relationships over the threshold for that particular channel. This threshold pressure relationship is likened to the lymphatics of the leg which are under increased pressure when the muscles are contracted as on standing or walking.

Marion's theory is somewhat more comprehensive. He has assumed that there are two types of non-parasitic chyluria, (1) secretory and (2) excretory. In the first type he cites the experimental work of Loeper and Ficat, who produced a lipuria by injecting mono-butyrine into the blood of rabbits. In the second type a fistulous communication is assumed, allowing the chyle to enter the urinary tract, due to traumatic rupture of the lymphatics or tumors, chronic inflammatory changes, etc., causing a lymphatic obstruction.

The influence of diet on non-parasitic chyluria seems pronounced in some case reports. Ludke was able to cause a disappearance of the chyluria by fasting. Tezner, Welfeld and others have been able to substantiate this to some extent.

Nearly all of the theories are insufficient and little better than those promulgated a half century ago. Such questions as unilateral chyluria with thoracic duct block, the rarity of chyluria and yet the frequency with which large abdominal and thoracic tumors occur are a few of the points in need for further explanation. The theory of lymphatic block and direct urinary tract communication is probably the most sufficient for the present.

#### CLINICAL DISCUSSION

*Occurrence*—Non-parasitic chyluria is rare, especially on the American continent. The greatest number of cases are those of European observers, who have called the condition "European chyluria" to distinguish it from the parasitic or tropical variety. This designation is a misnomer, the condition having been described elsewhere than in Europe. Goebel, in 1921, was able to collect 73 reported cases. These occurred chiefly in Europeans who had never resided in tropical countries. A review of the literature has brought the number well over one hundred. The occurrence in children is even more infrequent, but 12 cases having been reported. The occurrence of parasitic or filarial chyluria is more common, having been found in as high as 2 per cent of inhabitants in some regions (Magnus-Levy).

*Clinical Picture*—Non-parasitic chyluria occurs chiefly during early and middle adult life, although it may be found at all ages. Brandenburg's case was a seventeen months' old female baby, while Whelan's, Frank's and Rayer's cases were sixty-seven years, seventy years and seventy-eight years, respectively.

The milky or turbid appearance of the urine is usually the only presenting symptom with a sudden onset. An accompanying backache or renal colic may be the chief complicating complaint. This is considered as being due

## NON-PARASITIC CHYLURIA

to the fibrin clots occurring in the chyliform urine and moving down the ureter

Chyluria has presented some interesting features as to time and duration. It may be either continuous or intermittent. In Osterode's case it was intermittent for five years, occurring but several weeks each year, before becoming continuous. The relationship to time of day has been peculiar. Some observers have noted it to be present at all times, many have observed it in only the night urines, it clearing as the patient became active during the day (Oehme, Haddon, Goetze, Franz and Stejskall), still others noted chyle in the day urine only (Berli, Bence-Jones, etc.). Concatto found it only when his patient was in motion. Because of these various relationships to posture, a comparison to orthostatic albuminuria has been made. However, in this respect it differs from albuminuria since it usually occurs while the patient is lying down.

The urine has been the subject of much study. Magnus-Levy in a night kidney specimen found it fractionally to be 35 per cent urine and 65 per cent chyle. The fat content, using the Babcock method, has been estimated from 1 per cent to 3 per cent. Welfeld's first case contained 4.2 per cent. The albumin content may also be high, varying from 3 per cent to  $3\frac{1}{2}$  per cent. Other substances found in these urines have been lecithin, cholesterol, fibrinogen and soaps. Grossly the color of chylous urine varies from a cream or yellowish color to white. It may be tinged slightly red due to the presence of blood. Microscopically, the presence of occasional white blood-cells and red blood-cells can be demonstrated. The fat is in molecular form and therefore presents no morphology. The specific gravity is slightly less than normal. Since chyle is alkaline in reaction, some observers have shown chylous urine to be less acid than normally.

Diagnosis rests chiefly on a careful history and thorough urinary studies. Places of residence must be ascertained. The urine is to be differentiated from lipuria and marked pyuria. In the former the fat is present in the droplet form, although occasionally emulsified to the extent of a milky color. In such cases the presence or absence of fibrinogen, cholesterol or lecithin will be of significance. Lipuria is usually found associated with fractures, eclampsia, intoxication due to phosphorus, arsenic and carbon monoxide, diabetes, fatty degeneration in abscesses and degenerative renal processes. Usually in such conditions, the fat is found in the urine in large drops or after cooling, as tallow-like masses. It is brought through the blood stream (lipæmia) or may originate through the fatty degeneration of the renal constituents. Chronic nephritis with lipoid degeneration is a classical example (Ridder). The elimination of fat is not always pathologic. The researches of Sakaguchi upon himself and others have shown that there normally occurs 0.0085 of a gram in the urine per twenty-four hours. The presence of a greater amount than this figure, either macroscopic or microscopic, should be considered pathologic and the underlying cause sought for. Microscopic examination will differentiate the severe pyurias. Careful blood and urine examinations for



parasites should be performed. The history of residence in a tropical country though no parasites be found, should always make the observer suspicious of a parasitic chyluria. Manson has shown that filarial infections tend to disappear in later life, yet the changes made in the lymphatics may be productive of a chyluria.

Chyluria has on rare occasions been found associated with other diseases. Diabetes mellitus and chyluria have been noted by various observers (Stoller, Frank, Vogel, Magnus-Levy, Sanes and Kahn, Brandenburg). Pregnancy and chyluria, as well as chyluria post-partum, have also been found associated (Golding-Bird, Beiri, Concatto, Vaialdo, Davis, Veis, Bugbee). Mohr's case occurred in a four-year-old child with pharyngeal diphtheria. Trauma has also been mentioned (Whelan, Cauri). Keersmæcker's case is doubtful, an eight-year-old girl cleared of her chyluria following dilatations for enuresis. Tuberculosis of the peritoneum and carcinoma in the region of the kidney have also been named (Le Dantec), as well as pernicious anæmia (Vogelius).

Non-parasitic chyluria is usually a disease of long duration and because of its benignity has a fair prognosis. Rayer's case in a seventy-eight-year old woman was of fifty-five years' duration. Vieillard's case was twenty years, while Koopman's nineteen-year-old patient had had the condition since early childhood. Welfeld reported his case of fourteen years' duration. Very often the condition clears spontaneously while in others the loss of chyle leads to severe debility and finally death from exhaustion. The nature of the obstruction is of importance, since in case of malignancy the prognosis is poor. The nature of the associated conditions is also of importance.

The treatment has been one of great variation and diversity as would result in a disease so little understood as non-parasitic chyluria, hence it is chiefly symptomatic. The patient should be put on a low fat diet. Lavages of the kidney pelvis with weak silver nitrate solution (1 per cent to 3 per cent) may be used. Lower and Belcher cleared their case with neoarsphenamine. Should a patient progress poorly, renal exploration or even nephrectomy may be performed. The presence of any associated or complicating condition should also be treated. Fulguration or cauterization should be used where the point of communication can be demonstrated as in Bloch's case.

In the parasitic or filarial cases some success in treatment has been achieved in recent years. Deschamps using neoarsphenamine and Chabamei and Lobo-Onell with arsenobenzol reported successful treatment. Diamantis cured his case using antimony and sodium tartrate intravenously.

The use of sodium citrate has been found commendable in those cases suffering with renal colic due to the clotting of the chylous urine.

#### SUMMARY

1 A case of unilateral non-parasitic chyluria, associated with a perirenal abscess is reported.

2 Non-parasitic chyluria is of rare occurrence, especially on the American continent.

## NON-PARASITIC CHYLURIA

3. Its etiology is still on an hypothetical basis, the most probable being that of lymphatic obstruction with an abnormal communication between the lymph channels and the urinary tract

4 The symptomatology is characterized by the sudden onset, the milky urine, its periodicity and chronicity

5 Diagnosis depends chiefly on a careful history as to residence, urinary studies, and the failure to find parasites in the blood and urine on repeated examination Non-parasitic chyluria is to be differentiated from lipuria and severe pyurias

6 Non-parasitic chyluria has been found associated with diabetes mellitus, pregnancy, pharyngeal diphtheria, trauma, pernicious anæmia, tuberculosis of the peritoneum, as well as large growths in the region of the kidneys and the mediastinum

7 The prognosis in non-parasitic chyluria is usually good

8 Treatment is empirical The intravenous use of neoarsphenamine and pelvic lavages with 1 per cent to 3 per cent silver nitrate have given encouraging results Kidney exploration and nephrectomy have been done in the poorly progressing cases

## BIBLIOGRAPHY

### NON-PARASITIC CHYLURIA

- Ackermann Deut Klinik, 1863, vol xv, p 221  
Alibert Nosologie naturelle, 1817, vol 1  
Alibert and Caballe Ref Schmidt's Jahrbucher, vol xvi, p 51  
Angyan Pester Med chir Presse, 1893, p 28  
Bayet Hematochylurie non-parasitaire La Clinique, 1889  
Beale On Urine, Urinary Deposits and Calculi London, 1869, p 299  
Becigeul Gaz Med de Nantes, 1903, vol xvi, pp 405, 425  
Bence-Jones Medico-Chirurgical Trans, 1850, vol xxviii, p 313  
Bernasconi Cited by Marion  
Berti Speriment, Firenze, 1890, vol viii, p 114  
Bewley Trans Royal Acad Med, Ireland, 1899, vol xvii, p 26  
Biffis Il Polichnico, 1911, vol xviii, sez prat, p 1521  
Bloch Zeitschr f Urol, 1914, vols i-iii, p 422  
Boissard France Med, 1882, vol xxix, p 410  
Bouchut Gaz d'hôp, 1879, vol lii, p 847  
Bramwell Brit Med Jour, 1897, vol ii, p 261  
Bramwell Clin Stud, Edinb, 1905-1906, vol iv, p 239  
Brandenburg Deut Med Wchschr, 1909, vol xxxv, p 934  
Brieger Ztschr f Physiol Chem, 1880, vol ii, p 407  
Brieger Charite Annalen, 1880  
Bugbee J A M A, 1917, vol lxviii, p 693  
Cattani Gaz Med Ital lomb, Milan, 1881, vol viii, p 101  
Cestan et Pujol Gaz des hôp, 1913, vol lxxvii, p 640  
Charteris Lancet, 1911, vol ii, p 1011  
Ciauri Gior Med d r esercito, Rome, 1904, vol lii, p 256  
Cohn Ztschr f Urol, 1913, vol vi, p 3  
Cohnheim Vorlesungen u Allg Path, vol ii, p 384  
Concetto (Guareschi) Gior d Acad di Med d Torino, 1881, p 3  
Courty Prov Med, 1914, vol xxvii, p 215

- Daggett Brit Med Jour, 1896, vol 11, p 1706  
 van Dam Tydschr, 1918, vol 1  
 Davis Am Jour Obst, 1913, vol 1xviii, p 861  
 Dickinson Trans Lond Path Soc, vol xlix, p 391  
 Eggel Deut Arch f Klin Med, 1869, vol vi, p 421  
 Feuerstein u Panek Przegl lek Krakow, 1903, vol xlii, p 331  
 Frank, E R Assn Franc d'Urol, 1909, vol xii, p 252  
 Frank Munch Med Wchschr, 1908, vol lv, p 1464  
 Frank, J P De Curandis hominum morbis epitome Piae et Academicus dicta  
 Venetus, 1794, Liber v, p 39  
 Franz and Stejskal Ztschr f Heilk, 1902, vol xxiii, p 441  
 Fourcroy System des connaissances chim, 1801, vol v, p 412  
 Fourcroy et Vauquelin Ann de Chimie, 1800, vol xxxii, p 82  
 Gabbi Il Policlinico, 1904, vol xi, sez med, p 389  
 Gavin Louisville Med Monthly, 1897, vol iii, p 452  
 Glazier Lancet, 1877  
 Goebel Arch f Kinderheilk, 1921-1922, vol lxx, p 122  
 Goetze Die Chylurie Dr Diss, Jena, 1877  
 Golding-Bird Lond Med Gaz, Oct, 1843  
 Gonzales, Tanago and Garcia Siglo Med, Madrid, 1902, vol xlix p 621  
 Grimm Berl Klin Wchschr, 1885  
 Guyon Traite clin sur les Malad des vois urin, Paris 1881  
 Hoge Richmond Jour of Practice, 1903, vol xvi, p 263  
 Haddon Edinb Med Jour, 1879, vol xxiv, p 979  
 Hampton Bull Johns Hopkins Hosp, 1920, vol xxxi, p 20  
 Hertz Lancet, 1907, vol clxvii, p 733  
 Heuk Dermat Ztg, 1905, vol xii, p 706  
 Heuk Dermat Ztg, 1906, vol xiii, p 82  
 Heuk Berl Klin Wchschr, 1905, vol xlii, p 1026  
 Hnatek Deut Med Wchschr, 1910, vol xxxvi, p 794  
 Huber Deut Arch, 1887, vol cvi, p 126  
 Hunt Brit Med Jour, 1890, vol 1, p 421  
 Israel Mitteil u d Grenzgeb d Med u Chir, 1903, vol 11, pp 171 and 217  
 Jackson and Perty Cited by Franz u Stejskal, p 470  
 Keersmaecker Ann et Bull de la Soc d Med d'Anvers 1907 (Goebel)  
 Koopman Tydschr v Genesk, 1918, vol 1, p 19  
 Krause Munch Med Wchschr, 1912, vol lix, p 2261  
 Krieger Cited by Goebel  
 Lachowicz Rozprawy, etc, der Akademie der Wissenschaften in Krakau, 1886  
 Lafforgue Bull Soc Anat, Paris, 1912, vol lxxvii  
 Lazareff Ejened Jour "Prakt Med," St Petersburg, 1909, vol vii, p 629  
 Le Dantec Enc Franc d'Urol, 1923, vol vi, p 925  
 Lindsav Dublin Jour Med Sc, 1916, vol xcli, p 155  
 Litten Case cited in Berl Med Gesell Discussion, 1884  
 Loeper Cited by Marion  
 Loetz Die Chylurie, Jena 1887  
 Lowenstein Mitt d Gesellsch f inn Med u kinderkr in Wien, 1922, vol xvi, p 129  
 Lower and Belcher Surg, Gyn and Obs, 1924, vol xxxix, p 147  
 Ludke Munch Med Wchschr, 1908, vol lv, p 1369  
 Magnus-Levy Ztschr f Klin Med, 1908, vol lxi, p 482  
 Marion Ann des Malad des Org Gen Ur, 1910, vol xxxviii, p 193  
 McConnell Proc Med chir Soc, Montreal, 1882-1883  
 Mehu L'Urine, p 221

## NON-PARASITIC CHYLURIA

- Meyer *Mikroskopie u Chemie Krankenbett* by Lenhartz, p 343
- Moellenbroccius *Mictio chylosa* *Misc Acad Nat curios*, Lipae, 1670, vol 1, p 206
- Mohr *Munch Med Wchschr*, 1909, vol lvi, p 2552
- Monvenoux *Les Matieres graisses dans l'urine*, Paris, 1884
- Morawitz *Deut Med Wchschr*, 1918, vol xlv, p 143
- Morgagni *De Sedibut et Causis Morbor*, ed II, *Epist* vol xlii, p 44
- Moscato Cited by Stueitz and Fianz u Stejskal
- Myers *Brit Med Jour*, 1890, vol II, p 627
- Nasse *Ref Schmidt's Jahrbucher*, vol xv, p 221
- Neuberger *Deut Med Wchschr*, 1910, vol xxxvi, p 1548
- Oehme *Deut Arch f Klin Med*, 1874, vol xiv, p 262
- Ohmann-Dumesnil *Tri-state Med Jour*, 1897, vol iv, p 601
- Osterode *Ztschr f Urol*, 1915, vol ix, p 66
- Phillips *Clinical Soc Trans*, London, 1899, vol xxxii, p 216
- Pantaleoni *Il Policlinico*, 1923, vol xxx, sez prat, p 1622
- Ponfick *Tageblatt d 53 (Danziger) Naturforsch u aczte Versammlung*, 1880, Danzig, p 234
- Ponfick *Schmidt's Jahrbucher*, vol clxix, p 4
- Pope *Calif State Med Jour*, 1909, vol vii, p 285
- Port *Ztschr f Klin Med*, 1906, vol lix, p 455
- Predtetschensky *Ztschr f Klin Med*, 1900, vol xl, p 84
- Primavera *Giorn internaz delle Scient Med*, 1889, vol iv, p 4
- Prout *Schmidt's Jahrbucher*, vol xxi, p 53
- Prout *Stomach and Renal Diseases*, 1841
- Quarelli *Il Policlinico*, 1919, vol xxvi, p 121
- Quinke *Munch Med Wchschr*, 1912, vol lix, p 1361
- Raskai *Pest Med-Chir Presse*, Budapest, 1906, vol xlii, p 1244
- Rayer *Kritische Uebersicht der hauptsachlichsten in Europa gemachten Beobachtungen uber den chylosen, etc*, *L'Experience*, 1838, p 657
- Rayer *Maladies des reins*, Paris, 1841, vol iii, p 387
- Ridder *Berl Klin Wchschr*, 1912, vol xlix, p 22
- Roberts *A Practical Treatise on Urinary and Renal Diseases*, London, 1872
- Sakaguchi *Biochem Ztschr*, 1913, vol xlviii, p 1
- Salkowski *Berl Klin Wchschr*, 1907, vol xlv, p 51
- Salle *Deut Med Wchschr*, 1909, vol xxxv, p 142
- Sanes and Kahn *Arch Int Med*, 1916, vol xvi, p 181
- Schlossmann *Arch f Kinderheilk*, 1894, vol xvii, p 251
- Senator *Charite Annalen*, 1883, vol x, p 307
- Senator *Eulenberg's Realenzyklopadie*, 1894, vol iv, p 648
- Siegmund *Berl Klin Wchschr*, 1884, vol xxi, p 150
- Slosse *Il Policlinique*, 1902, vol xi, p 361
- Slosse *Soc Roy d Sc Med et Nat de Brux Bull*, 1901, vol lix, p 96
- Sohs-Cohen *Cincinnati Lancet-clinic*, 1889, vol xxi, p 597
- Stalpart van der Wiel *Medici Hagensis Observ Rar Med Anat Chir Luydusum Batar*, 1687, Liber II, p 391
- Stockmann *Glasgow Med Jour*, 1902, vol lviii, p 366
- Stoller *Ein haufiger und anhaltender Abgang des Chylus mit Wenig urin, welcher durchaus wie milch aussah u plotzliche Verzehrung drohte Beobachtungen u Erfahrungen*, Gotha, 1777, pp 3-24
- Strauss *Munch Med Wchschr*, 1911, vol lviii, p 2765
- Surmount *Bull Soc Centr de Med du Nord*, Lille, 1902, p 272
- Tezner *Monatschr f Kinderheilk*, 1922, vol xliii, p 271
- Theilemann *Dr Diss*, Halle, 1906

## ADOLPH A KUTZMANN

- Thudichum Schmidt's Jahrbucher, vol cxxiv, p 270  
 Thudichum A Treatise on the Pathology of Urine, London, 1858  
 Tyson Syst Pract Med, Pepper, 1886, pp 114-122  
 Veraldo Ginecol mod, Genova, 1909, vol II, p 137  
 Veis Berl Klin Wchschr, 1905, vol xl, p 27  
 Vieillard Jour de Phar et de Chimie, 1899, vol v, p 53  
 Vogel Sammlg Schwieriger Med u Chir Falle, Nurnberg, 1807, vol II, p 334  
 Vogelius Kopenhagen Hosp Tidende, 1879, p 22  
 Voit Deut Med Wchschr, 1909, vol xxxv, p 2213  
 Waldvogel und Bickel Deut Arch f Klin Med, 1902, vol lxxiv, p 511  
 Van der Weyde Nederl Tijdschr u Geneesk, 1896, vol xxxii, p 583  
 Welfeld Jour Urol, 1924, vol xii, p 19  
 Welfeld J A M A, 1924, vol lxxii, p 110  
 Whelan Med Record, 1890, vol xxxvii, p 184  
 Wilkens A Case of Chyluria Hygiea, 1888  
 Wilson Lancet, 1884, vol II, p 1128  
 Winternitz xxi Kongress f inn Med, 1904  
 Wolff Zur Lehre der Chylurie Inaug Diss, Berlin, 1891  
 Young Jour Trop Med and Hyg, 1914, vol xii, p 241

### PARASITIC CHYLURIA

- Carter, D W Arch int Med, 1916, vol xiii, p 541  
 Carter, H V Medico-chir Trans, 1862, vol xlv, p 290  
 Chabenier et Lobo-Onell Jour d'Urol Med et Chir 1923, vol vi, p 128  
 Deschamps Bull Acad de Med, 1919, vol lxxvi, p 655  
 Diamantis Jour d'Urol Med et Chir, 1923, vol vi, p 471  
 Hartmann-Keppel Jour d'Urol Med et Chir, 1922, vol xiii, p 359  
 Havelburg Virch Arch, 1882, vol lxxix, p 365  
 Mackenzie Trans Path Soc Lond, 1882, vol xxxiii, p 394  
 Manson Indian M Gaz, Calcutta, 1901, vol xxxvi, p 281  
 Manson Davidson's Hyg and Disc of Warm Climates, p 814  
 Manson Tropical Diseases, 1914, v edition  
 Rosenheck and Rohdenburg New York Med Jour, 1911, vol xciii, p 372  
 Scheube Volkmann's Sammlg, Leipzig, 1883, p 232  
 Stuertz Deut Arch f Klin Med, 1903, vol lxxviii, p 557  
 Waters Med Chir Trans, 1862, vol xlv, p 209

### MISCELLANEOUS

- Perves Jour d'Urol Med et Chir, 1923, vol xvi, p 121  
 Pecquet Cited by Sanes and Kahn

# THE MECHANISM OF ACUTE OSTEOMYELITIS

BY ABRAHAM O. WILENSKY, M.D.  
OF NEW YORK, N.Y.

THE present discussion includes only those cases of osteomyelitis caused by the ordinary forms of pyogenic bacteria, staphylococci, streptococci, etc. Cases due to infection with bacillus typhosus have a similar mechanism and biology and are included in this discussion. Cases due to infection by tubercle bacilli, syphilitic virus or actinomyces are not included, nor any case originating in such obscure pathology as that associated with thrombo-angitis obliterans, senile vascular gangrene, Volkmann's contracture, etc., nor with the forms of gangrene associated with diabetes mellitus.

The old terminology used in association with the phenomena of bacterial infection and including such terms as sepsis, septicaemia, sapraemia, pyaemia, etc., will not be employed in this communication. The reasons for this were described in another communication and a simplified terminology was suggested. In this communication only the following terms—infection, bacteraemia and general blood infection—will be employed with the following definitions:

1 The term "infection" will be used as a generic one and will include all of the phenomena of a bacterial attack on tissue, organ or the entire body. The various kinds of infection will naturally be described in accordance with the tissues, organ, or part of the body involved, and in accordance with the organism, or organisms encountered; thus saprophytic infection of the uterus, staphylococcus infection of the skin, or streptococcus infection of the liver, etc. When no other modifying term is employed it is to be assumed that cultivations of the peripheral blood taken during life are sterile. The differentiation commonly made between local and general infection theoretically does not exist and the terminology is one more of convenience than of accuracy. Local infections must necessarily involve some degree of general constitutional reaction and general infections must necessarily find their beginnings in, or be associated with a local focus of infection. As far as possible this differentiation will be avoided or made clear in the text whenever it must be used.

2 The term "bacteraemia" will, also, be used in a generic sense to indicate any condition in which bacteria can be cultivated from the peripheral blood during life. The various kinds of bacteraemia will, also, naturally be described in accordance with the organism found, thus staphylococcus bacteraemia, streptococcus bacteraemia, etc.

3 The term "general blood infection" will indicate a subgroup of the generic term "bacteraemia" and in this communication a distinction will be made between the terms "bacteraemia" and "general blood infection" on the following basis. The term bacteraemia is meant to imply a condition in which the organisms demonstrable in the circulating blood by the usual cultural methods are derived from a local lesion somewhere in the body, are usually small in number and the faculty of destroying the circulating bacteria is more or less retained by the appropriate antibodies of the blood. The term "general blood infection" is meant to imply a condition in which in addition to the foregoing, a multiplication of the bacteria takes place in the circulation and the faculty of destroying the circulating bacteria is more or less lost by the appropriate antibodies of the blood.

Under appropriate circumstances both of these groups of terms will be employed together, thus staphylococcus infection of the skin with staphylococcus bacteraemia or general blood infection. The character of the local lesion in the complete development of any individual infection is best described by the use of the terms "primary," or "secondary" ("metastatic," "subsidiary"), thus "primary staphylococcus infection of the skin with staphylococcus bacteraemia," or "primary streptococcus infection of the tonsil with secondary streptococcus infection of the appendix," etc, the absence of any descriptive bacteraemia indicating that a cultivation of the peripheral blood made during the course of the illness was sterile

There are two fundamentally different classes of cases of acute osteomyelitis (1) The group in which infection of the bone structure is of an exogenous source and is conveyed from the outside *via* a communication through the covering soft parts, and (2) the group in which infection of the bone structure is of a hæmatogenous origin. Group 2 is of much more importance and of far greater significance than the first group

There is a third group in which apparently infection plays no part. I refer to the kind illustrated in Fig 1. A trauma becomes applied to a surface of bone resulting in the rupture of some of the periosteal perforating vessels and in a subperiosteal hæmatoma. A disturbance of the blood supply in a superficial part of the cortex follows and a scale of bone eventually sequestrates. The inflammation surrounding this area is of a reparative nature and has no relation to infection.

FIG 1.—Diagrammatic representation of periosteal (B) circulation and that derived from nutrient artery (C). At (D) is the anastomotic area.

Such trauma may be accidental or purposeful (operative). The whole process may, however, accidentally or otherwise, be combined with infection.

**Group I—A** An osteomyelitis can follow as a result of infection introduced from without. In some way—a stab wound or punctured wound, etc,—a communication is established between the outside of the body and the bone structure. The best examples of this variety are the felons of the terminal phalanges of the fingers in which infection of the bone commonly follows a

## THE MECHANISM OF ACUTE OSTEOMYELITIS

~~puncture~~ with a needle Infection is introduced here from without, without the agency of the blood stream In the ordinary civil type of osteomyelitis having its origin in this fashion, the area of bone infected is comparatively and actually small The process is quickly and sharply delimited and the segment of osseous tissue which dies and sequestrates is inconsequential

The pathological picture in this variety of case includes an immediate killing off of a circumscribed portion of the soft parts overlying the bone which because of the communicating vascular channel usually extends down to and includes the periosteum and superficial layers of the cortex of the bone This circumscribed area separates in its entirety and sloughs away, the bone sequestrum coming away with it, thereafter the wound promptly heals Clinically these processes are accompanied with a great deal of pain

B In another variety the bone is involved in an extraneous process occurring nearby because of contiguity of structure The best example of this is the form of osteomyelitis occurring in the ribs as a complication of an intercostal thoracotomy for empyema Even though in this type of operation the bone tissue is not exposed, in practically every instance, because of the continued pressure of the drainage tube, the bone becomes bared sooner or later The process includes a complete pressure necrosis of the covering muscle, fascia and periosteum and an inflammatory process of bacterial origin in the superficial cortical layers of the rib Most often the process in the bone subsides spontaneously and no sequestration occurs, in a fair proportion of the cases, sequestration does, however, occur

It must be a very rare occurrence indeed for an osteomyelitis to develop by contiguity of structure from an abscess in the soft parts close by without the mechanism of a pressure necrosis I have seen many times an abscess situated in close relationship with a bone, but the periosteum has always remained intact and the osseous tissue has not become exposed Whenever bared bone is felt in the bottom of such an abscess, it can be taken for granted that the process is primary in the bone—usually in its periosteal layer—and that the abscess is a secondary manifestation

Thoracotomy with rib resection for empyema represents the best example of the group of cases in which bone tissue is directly infected during an operation Because of this tendency in a large proportion of the cases, it has been suggested by some men that the steps of the operation be so arranged that no opportunity be afforded for infection to be implanted in the open surface of the resected rib, the method suggested has consisted in fashioning a flap from the adjacent soft parts with which the cut surface of the rib can be efficiently covered The reports available at first were optimistic, but the absence of confirmation since then apparently indicates that the technic described has been found to be not necessary by most operators or has not been successful Practically, it is found that the infection of the rib is not a serious consequence and serves only to delay the healing of the wound In obstinate cases radical removal of the infected portion of the rib



becomes necessary subsequently. A bacteraemia is never demonstrable, except as an ante-mortem phenomenon.

Another variety of this group includes the infected compound fractures of civil life. The process here includes a traumatic baring of bone tissue both on the surface and in the interior upon, and into which, infection is mechanically introduced. In a fair number the infection is, practically speaking, only a contamination and nature aided by the debridement of the wound effectually throws off the contamination so that no consequence of the latter remains either immediately or makes its appearance later. In a few, however, contamination takes root in the exposed bone surface and becomes a true infection. Later a variable segment of bone sequesters, then the wound promptly heals, this happens in a fair proportion of the cases.

In others of the compound infected fractures in which infection becomes established, the process becomes centred in the callus. As the latter grows in amount and becomes definitely organized, foci of infection become inclosed in the cancellous structure. Clinically this fact is corroborated by the practical impossibility of effectually sterilizing such a wound by the Carrel-Dakin technic and on the appearances of new evidences of infection in the wound after its apparent closure. The infected areas are usually lodged in granulation tissue between the bony planes of the cancellous structure. The chances of an immediate or permanent spontaneous healing depend upon the character of the infecting agent, the resisting powers of the individual, the age of the individual, and certain mechanical conditions in the wound concerning which we shall speak later in this communication.

If wounds of this type are well taken care of promptly and the cicatrization is so controlled that the wound closes from its very bottom, the usual course of events includes a slow but sure healing. The Carrel-Dakin method, however, is of no help, nor does it materially hasten the healing, the reasons for this were pointed out on another occasion (Wilemsky, *ANNALS OF SURGERY*, June, 1922).

In a certain number, operative removal of the infected area and mechanical correction of the mechanical disability are necessary before the wound will heal. In my own experience, it has always happened that once such a wound healed, it remained healed and was not generally subject to the numberless recurrences characteristic of certain other forms of osteomyelitis.

Under ordinary circumstances and as a general rule, cases in the group just outlined are not associated with general blood infections.

Group II—The ordinary case of acute osteomyelitis results from a bacteraemia or general blood infection, the origin of which is in the greatest number of cases obscure. In these cases it is thought that the entry point of the infection must necessarily be some surface (skin or alimentary canal) of the body, in actual practice it is assumed that, with very few exceptions (genito-urinary infections, furuncular infections of the skin) this surface is the mucous membrane lining of the alimentary canal at points where collections of lymphadenoid tissue are especially prominent (tonsils, especially—

## THE MECHANISM OF ACUTE OSTEOMYELITIS

Peyer's patches—etc ) At the latter areas a lesion need not necessarily be demonstrable. The mechanism of the portal of entry of any infection has been discussed in another communication. In a small minority the bacteriæmia or general blood infection accompanies or follows a definite entity such as typhoid fever, or a definite focus of infection is present somewhere in the body—a phlebitis, a postpartum sepsis, a furunculosis, etc., to which the bacteriæmia or general blood infection is subsidiary and through which in turn the osteomyelitis originates.

In any case the focus in the bone is a fixation point to which the bacteria circulating in the blood are attracted. Commonly there is a single one of these fixation points following which a single focus of osteomyelitis develops. But just as often there are more than one of these foci developing either simultaneously or subsequently the one to the other. When the number of the latter is more than one, some of the fixation points may be located in tissues and structures other than bone, as for instance, in a joint, or in the fascial planes in the musculature of a limb. Under appropriate circumstances, which depend altogether on the character and physical results of the inflammatory process developing at the fixation point, the latter, in turn, forms a point of distribution from which a bacteriæmia or general blood infection may occur and from which subsidiary foci can develop in exactly the same way.

There is no experimental or other evidence which helps in classifying multiple foci developing during the course of an osteomyelitis—or in fact during the course of any infection. It is perfectly possible for the primary lesion to father every secondary or subsidiary focus that may ever develop, and on the other hand, it is just as possible for any secondary focus to in turn form a point of distribution. Sometimes I have thought that I have been able to make the distinction in conditions of the following kind. Several foci develop at approximately one time and these having been adequately treated, undergo an apparent healing. Subsequently trouble develops in one of these foci only and coincident with, or subsequent to, this exacerbation other new foci develop. The fact that one of the original foci is in "active eruption" has made me feel that it in turn is a point of distribution.

The bacteriæmia through which primary or subsidiary foci become established and develop are not always demonstrable. It is well known that these states may be of temporary duration and the presence of bacteria in the circulating blood, even for a short period, is sufficient to infect any local area. It is thought that temporary states of bacteriæmia are constantly occurring even in conditions of health and that the natural forces of the body are amply sufficient to overcome these so promptly that no evidence of them is perceptible in any way. It is also known that during the dressing of any wound—more so, perhaps, with a wound of bone—bacteria may be pushed into the circulation so that a temporary bacteriæmia is present, this ordinarily lasts only a few hours, is occasionally demonstrable and has no clinical signs or demonstrable effects.

CASE I—The patient had been operated upon previously for an osteomyelitis of the femur. By the end of the second week the wound looked healthy, there were no other foci demonstrable, the fever was practically at the normal level and there was no reason to suspect a bacteriæmia. A blood cultivation which was accidentally made within a short time after a dressing showed several colonies of staphylococcus aureus. This, too, was, undoubtedly a temporary bacteriæmia. Other blood cultures were uniformly negative.

While in extraordinary circumstances bacteria can pass through a surface of the body (tonsils, for instance) and multiply in the blood, the available

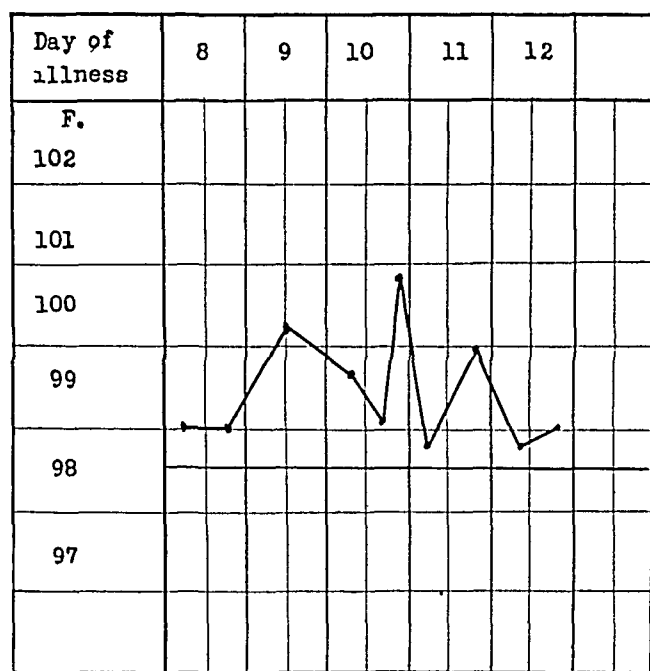


CHART I —(Case I)

knowledge seems to show that ordinarily bacteria circulating in the blood depend for their existence there primarily upon the presence of an infected thrombus. This was pointed out in another communication. The course of events is one of two: (1) Microscopic pieces of thrombus carrying a number of living organisms break off and circulate through the blood stream until they are disposed of in some way. Sometimes isolated organisms growing on the surface of the thrombus or groups of them in the forms of bacterial emboli are cast off into the blood stream without any particle of the thrombus itself coming away. Clinically, this is a bacteriæmia, as previously defined. Fortunately in most of these instances the natural antibodies destroy the organisms as fast as they are discharged into the circulation and no subsequent effect is noted. In the minority an infected embolus caught into the capillary network of bone tissue and held there becomes a fixation point and furnishes the initial stage of a focus of osteomyelitis. The fact that fragments of the original embolus after it has been arrested in bone tissue or of its secondary thrombus thereafter may in turn break off and circulate in the blood furnishes the physical basis for the occurrence of secondary points of distribution. This explains the statements made in the previous paragraphs. (2) In addition to this the virulence of the bacteria may be sufficient to enable them to multiply in the blood stream.

The physical characteristics of the infected thrombus-embolus formation (fixation point) and its resultant effects in the bone and the multiplication of bacteria in the blood stream have direct effects on the clinical picture as regards the association of a bacteriæmia.

## THE MECHANISM OF ACUTE OSTEOMYELITIS

In actual practice it is found that cases of osteomyelitis can be of three kinds

(1) In the first variety a focus of osteomyelitis is present with well-marked local signs and symptoms but without any clinical signs of a general blood infection. A bacteraemia is not present. The physical basis for this variety lies (a) in a primary and temporary bacteraemia, (b) in the development of a fixation point in a bone, and (c) in the subsequent spontaneous disappearance of the bacteraemia.

(2) In the second variety a well-marked focus of osteomyelitis is present with abundant local signs and symptoms and, in addition, there are clinical indications of a bacteraemia as evidenced by the general signs and symptoms and by the demonstration of living bacteria in the blood stream. The physical basis for this variety is the presence of an infected thrombus-embolus formation which serves to keep up a demonstrable bacteraemia by constantly feeding into the blood stream a comparatively small number of viable organisms. Most commonly, after efficient surgical treatment, the bacteraemia eventually disappears and a recovery is made. It must be remembered that any of these cases may at any time pass into the third group. The possibility also exists, as mentioned in a preceding paragraph, of the local focus of osteomyelitis in cases of this variety becoming a secondary point of distribution.

(3) The clinical picture of the cases in this group is that of a profound general infection: there is a marked toxæmia. A local focus of osteomyelitis is either not demonstrable at all because of the paucity of local signs and symptoms, or because the latter are hidden in the profound intoxication, or, if present, the local lesion is easily recognized as being of no consequence in the total clinical picture. The physical basis of the picture lies in an extreme and severe general blood infection with highly virulent organisms in which the bacteria are rapidly multiplying in the blood stream and because of which the subject is rapidly being overwhelmed by a tremendous intoxication. The presence of the infected thrombus-embolus formation forms a negligible factor and the few organisms that are derived from this source play only a primary and inciting part in the production of the bacteraemia; the subsequent multiplication in the blood stream depends on other factors, the most important of which lie in the high virulence of the infecting organism and in the poor resistance of the subject. An endocarditis is usually found under these conditions. In this variety the local point of fixation in the bone plays no rôle in the production of any part of the clinical picture. Usually the inflammatory picture in the bone—the osteomyelitis—is not in a very advanced stage at the time the lesion is exposed, either on the operating table, or, as more commonly happens, in the autopsy room.

In actual disease it seems certain that the cases differentiated in these three groups form progressive stages each from the next preceding group. A case in Group I may pass into Group II, and, conversely, a case in Group II, having been appropriately treated, may retrogress into Group I as it proceeds to healing and recovery. These interchanges are constantly occurring in clinical

cal surgery A case in Group II may pass into Group III as is previously noted, usually under such conditions there is a continued progression until the eventual fatality In actual practice cases in Group III must necessarily first pass through the stage indicated by Group II, the time interval may be so short, however, owing to the virulence of the infecting organism, as to be unrecognizable One can explain the cases that apparently begin with the

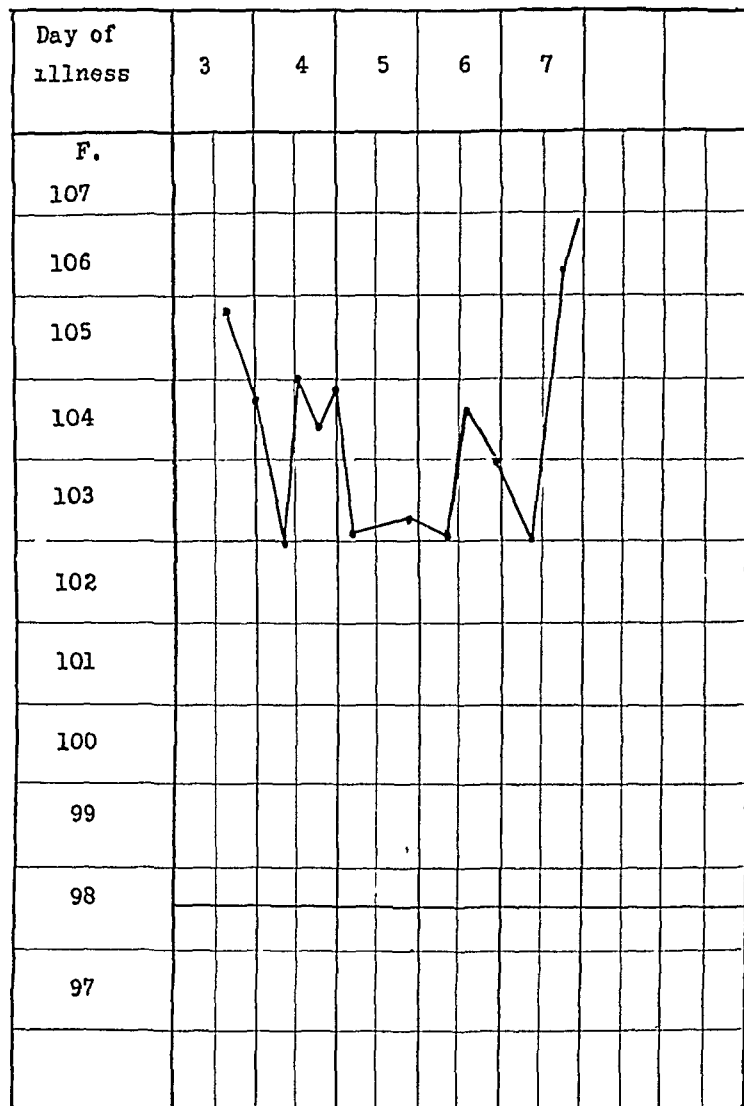


CHART 2 —(Case III)

characteristics of the cases in Group III in this way In many cases characteristics can be distinguished which belong to both Group II and Group III, and insofar as any case partakes of characteristics not belonging to its group, it differs in its clinical manifestations I have never seen a case in Group III retrogress spontaneously into Group II, it seems almost impossible to believe that such retrogression can ever occur

The following cases illustrate these various groups of osteomyelitis

CASE II—Following the recovery from a lobar pneumonia, a swelling developed over one of the ribs Upon incision this was demonstrated to

be a subperiosteal abscess and necrotic bone was felt in the bottom of the wound Pneumococcus type I was isolated from the pus A blood culture was sterile

CASE III—A young man was admitted to the hospital with the clinical signs of a profound infection There were abundant subjective and objective physical signs of a well established focus in one femur which had followed the kick of a horse A blood cultivation of the peripheral blood showed 25 colonies of staphylococcus aureus per cubic centimetre of blood An osteotomy was immediately done and extensive drainage was instituted The pus contained staphylococcus aureus also The course of the illness is exemplified by Chart 2 and a fatality occurred Numerous colonies of the same organism were isolated from the peripheral blood before death

## THE MECHANISM OF ACUTE OSTEOMYELITIS

CASE IV—A young child was seen in a most profound intoxication evidently the result of a general infection. With great difficulty it was established that a focus was present in one clavicle and during the exploration, only a discolored bone with some œdema of the surrounding periosteum was demonstrated. A blood cultivation made before operation showed 10 colonies of staphylococcus aureus per cubic centimetre of blood. One made after operation showed 120 colonies of the same organism, death occurred at the end of the first twenty-four hours.

From what has been said heretofore, it must be apparent that in any given case the presence of a bacteriæmia can be referred (1) to the primary lesion, (2) to its secondary focus in the bone, (3) to the presence of a focus subsidiary to the secondary focus (bone or other) which by itself is capable of creating a bacteriæmia, (4) to the presence of an endocarditis, and (5) to the presence of some other complication capable itself of giving rise to a bacteriæmia or general blood infection. In any given case it is always important to be able to properly classify the bacteriæmia which may be demonstrable. The clinical possibilities are the following:

1. In many of the cases a single focus of osteomyelitis only is demonstrable. In most of the cases in this group the comparatively small number of bacteria demonstrable in the blood circulation (plate culture method) indicates that the bacteriæmia results from the demonstrable local lesion. If, following an adequate operation in which the entire bone focus is removed, the blood becomes sterile, it can properly be assumed that the bacteriæmia had resulted from the demonstrable lesion. In some of the cases, however, the bacteriæmia persists for a variable time after operation. When the surgeon is certain that the bone lesion has been so thoroughly removed as to be impossible of causing the bacteriæmia and when the appearance of the bone wound corroborates this impression, the bacteriæmia should be used as an indication that some other focus exists which must be found and removed in order to render the blood sterile. Many times this proves to be the case, but when it does not, the original focus of osteomyelitis should be examined again and revised operatively. If the bacteriæmia still persists and the number of demonstrable bacteria is still comparatively small, an explanation of the bacteriæmia becomes impossible for the moment, although it must necessarily be assumed

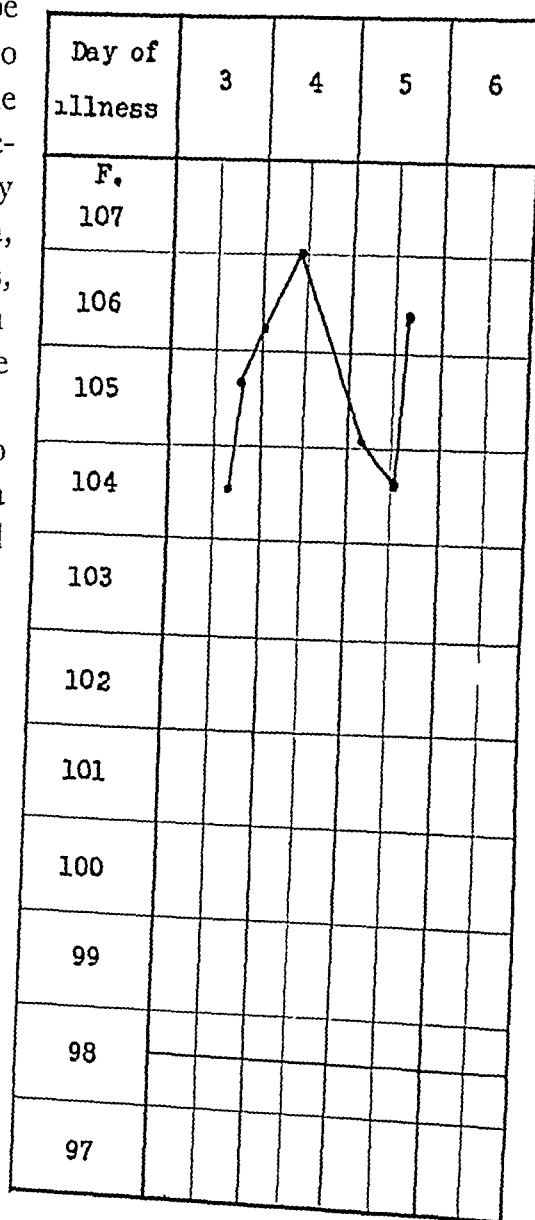


CHART 3 —(Case IV)

that some other focus does exist which is causing the bacteriæmia, and which must be demonstrable. Undoubtedly in some cases an obscure primary lesion exists which serves to keep up the bacteriæmia. Fortunately in most of such cases the natural forces of the body are ample after a sufficient lapse of time to render the blood sterile. A bacterial endocarditis must be excluded in all of such cases.

2 When several foci of osteomyelitis coexist in the presence of a bacteriæmia, the explanation of the latter becomes a matter of exclusion. Similar rules to those outlined in the last paragraph apply.

3 In a few of the cases, comparatively speaking, the primary lesion is demonstrable as well as one or more subsidiary bone lesions. In the majority of the cases primary or other, the primary bacteriæmia disappears after efficient surgical treatment directed towards all of the demonstrable lesions. In a few cases, however, the bacteriæmia persists. Although in some of the latter cases, because of the character of the infecting organism, or because of other reasons, it is possible to say with a fair degree of certainty that the primary lesion is keeping up the bacteriæmia, in all of the others the proper explanation becomes a matter of exclusion also in accordance with the rules laid down.

4 In some of the cases of bacteriæmia a subsidiary focus has developed in a tissue or organ other than bone, or a complication develops which is unrelated to the osteomyelitis. Except in those cases of complication in which the latter is known from previous experience to cause a bacteriæmia or general blood infection, the proper explanation again becomes a matter of exclusion as previously indicated.

In any of these groups it is important to know the relative quantitative degree of the blood infection by an estimation of the number of organisms per cubic centimetre of blood (plate culture method). Then a comparison of any one blood examination, either with preceding blood cultures or with subsequent ones, readily gives a method of distinguishing whether improvement is, or is not, occurring.

5 Any of the local conditions indicated in the preceding four groups may be associated with a general blood infection in which the blood cultivations show that large numbers of viable organisms are circulating in the blood. It is to be assumed under such conditions that the bacteria are multiplying in the blood in addition to whatever else they are doing, the prognosis must therefore be a very serious one. The usual course of affairs includes a steady progression of the general blood infection until a fatality occurs. Very exceptionally improvement occurs and the patients recover. Some patients are admitted to the hospital when the general blood infection has already reached an extreme degree—that is, in a very high grade of infection, such patients should not be operated upon for any of their local lesions as they invariably die within a very short time.

Patients in the first four groups of this classification may, at any time, as has been indicated previously, pass into Group V. They then assume characteristics of this group and the clinical manifestations increase in gravity pro-

## THE MECHANISM OF ACUTE OSTEOMYELITIS

portionately and absolutely. It is very rare for the opposite course to be followed.

In the group of osteomyelitis with bacteraemia, the disappearance of viable bacteria from the blood stream, as demonstrated by the blood cultivations, is many times due to the mechanical operative removal of the part of tissue carrying the infected embolus-thrombus formation. In others, the disappearance of the bacteraemia is a sudden thing due to the extrusion of the infected clot into the wound surface, or to other non-demonstrable cause of generally similar nature, or to the control of the infection by the relatively strong natural resisting powers of the individual. In still other cases, the bacteraemia becomes a more chronic affair and persists for some time before finally disappearing, anatomically this must be due to a slow healing of the lesion and the isolation of the infected clot by dense scar tissue or, functionally, by the slow sterilization of the infected environment by the natural forces of the body.

In actual disease fixation points in any bone must be determined by some kind of local trauma at the given point. I include under the general term of trauma all varieties—mechanical and physical trauma, chemical trauma, etc. In clinical experience the cases group themselves into (a) those in which there is a distinct history of a definite physical trauma and (b) those in which no such history is elicitable.

a Cases in which the trauma is a distinct physical entity are, of course, very common. I give the notes of one case in which the sequence of events is very suggestive.

CASE V—A young boy sustained a fracture of the radius. There was absolutely no wound of the skin. When the cast was removed at the end of about ten days a sinus was disclosed which led to carious bone. Apparently the boy had been well up to the time he sustained the fracture and there was no indication of any general blood infection. However, a temporary bacteraemia must have been present probably of the kind previously referred to as the infection must be a hæmatogenous one.

This is an extreme case of trauma. There are many, many other cases in which the degree of the trauma and its extent varies all the way down to minor grades and until it is so slight as to be barely, or not recognizable. I know of one case in which trauma preceding the osteomyelitis was a sprain during a football match.

The physical basis for this consists of a hæmatogenous infection in a gross or microscopic hæmatoma associated with blocking of the circulation at one or more points because of the tearing of the vessels, this is a fixation point for any bacteria carried in the blood stream.

There are other cases in which trauma occurs accidentally during the course of a well-established bacteraemia. In cases of general infection the mildest trauma is almost certain to be followed by local infection. The common locations are not in the bone most commonly they are situated in the soft parts of the limbs. In many cases the trauma is so slight as not to be recognized.



b This group includes all the cases in which there is no history of trauma. Undoubtedly in some, at least, of the cases in this group, trauma was present but passed unnoticed, most probably, because of its slight degree, or because of some other undiscoverable cause.

It is possible that in some of these cases, a certain form of negative or passive trauma is produced by a temporary disturbance of the capillary circulation in a circumscribed area of a bone leading to a temporary localized anæmia. This might conceivably be produced by a fragment of blood clot,

which, having become dislodged at some other distant point, becomes caught in the capillary network of some bone. Necessarily the embolus need not carry bacteria, but, once having been arrested in its circulation, it furnishes an ideal environment for the attraction of viable organisms circulating in the blood.

Circulatory changes which cause changes in nutrition are the physical basis for the "chemical traumata" which I mentioned previously. Many cases with no definite etiological history of trauma undoubtedly, have this form of trauma as a contributing cause.

In actual disease, fixation points in any bone depend a great deal upon the physical characteristics of the blood-vessel structure in the interior of the bone. A typical specimen of the circulation in a long bone is shown in Fig 2. There is a separate circulation for the diaphysis and for the epiphysis. The circulation of the epiphysis enters most often at more than one point, though very often a main channel can be distinguished. The circulation of the diaphysis is derived from a large vessel, the nutrient artery of the bone which enters a little to one side of the centre shaft. Immediately, the main vessel divides into a number of large branches which pass

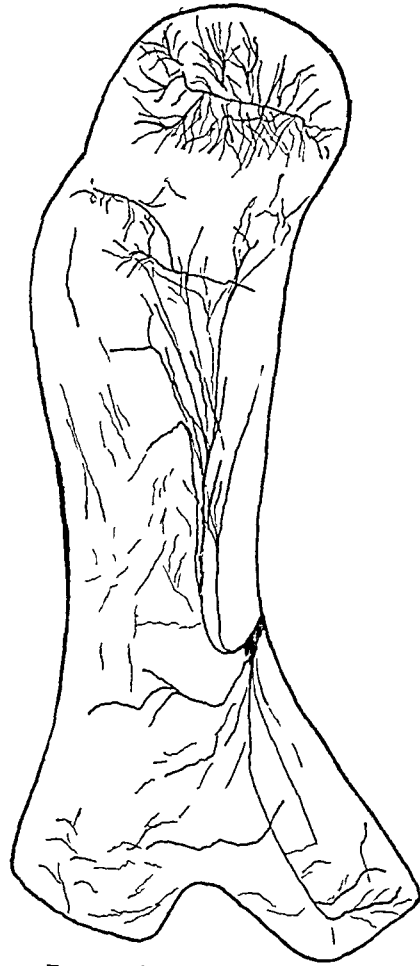


FIG 2—Injection specimen of a long bone. Copied from *Untersuchungen über Knochenarterien* by E. Lever, Kulig and Turk.

some of them upwards and some of them downwards towards either end of the shaft. A diffuse network is formed which supplies the entire interior of the bone and its medullary cavity. Towards the end some of the main branches become end vessels. There is a free anastomosis between the plexus of vessels thus established and the vessels derived from the periosteum through Sharpey's fibres. In a growing bone, with the epiphyseal cartilage still present, there is little direct anastomosis between epiphysis and diaphysis and a relative avascular area results, in a fully grown bone there is an extensive anastomosis between the two.

## THE MECHANISM OF ACUTE OSTEOMYELITIS

A fixation point is formed by the arresting of an embolus (or by a thrombus formation) at some point of this vascular network. The actual point depends more on chance than on anything else, and is decided by the physics of the local bone circulation at the given moment. Various pathological pictures result, depending on the size of the plugged vessel, relative position of the plug, the powers of vascular anastomosis, etc., in conjunction with the character, virulence, etc., of the bacteria giving rise to the infection. The dominant characteristics of the pathological picture are (1) a thromboarteritis or thrombophlebitis, and (2) a necrosis of the bone cells consequent to the disturbance of circulation. The physical characteristics of the pathological picture depend to the largest extent upon the second factor. The following general pathological pictures form the main varieties.

I refer again to Fig. 1. In addition to the rupture of Sharpey's fibres, and the subperiosteal hæmatoma infection enters and centres in one or more of the thrombosed vessels. In many cases infection is brought from the bone side of the circulation. Depending on the amount of disturbance of capillary circulation, disturbance of nutrition occurs in the cortex of the bone and usually it is a relatively larger segment of cortex, the resulting sequestration is correspondingly larger than would happen in an otherwise sterile trauma of the kind indicated. On the other hand if the infection enter the clotted area from the periosteal side of the circulation, infection centres in the clot at the relative point, A (Fig. 1) and a subperiosteal abscess forms. This is the variety of case in which, after proper incision of the subperiosteal abscess, healing occurs without interruption and with permanency and without involvement of the cortex.

Figure 3 represents conditions when an embolus-thrombus formation occurs in the main nutrient vessel of a bone before its division into its primary branches. Secondary clotting is widespread throughout the entire intraosseous vascular network. The disturbance of blood supply for the given bone is of maximum degree and subsequent necrosis of the entire diaphysis is the rule. The formation of the subsequent protective involucrum is entirely due to the scathless condition of the periosteal circulation, the latter is further fortified by a physiological dilatation of the vessels and by a consequent marked increase in the amount of blood brought to the affected environment. Under the influence of a very great increase in the supply of food thus brought to the periosteal osteoblasts, the dormant activity of the latter receives a powerful stimulus, new bone cells appear, new Haversian systems are formed, and new true bone tissue surrounds the sequestered portion of the shaft, an involucrum is thus formed.

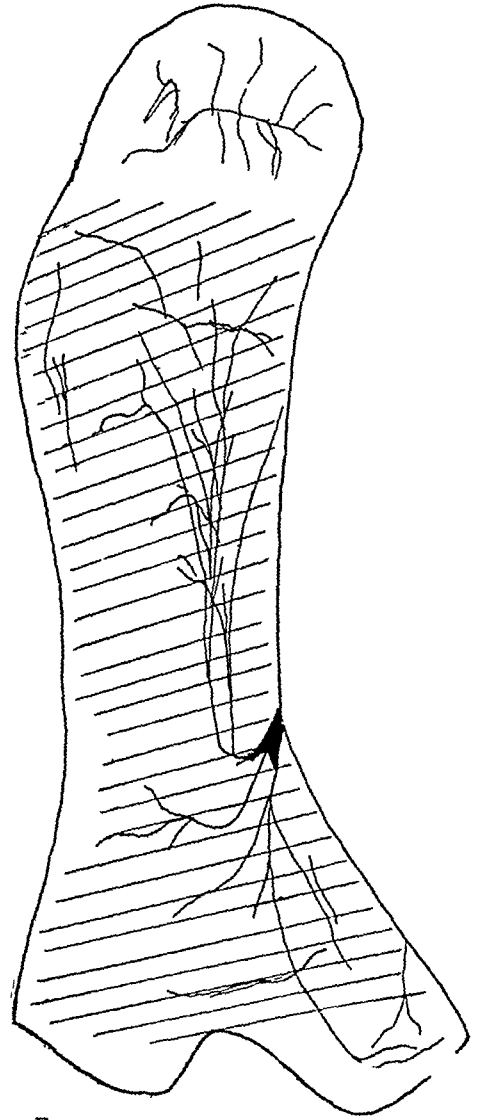


FIG. 3.—Diagrammatic representation of blood supply of long bone after Fig. 2. The shaded area represents approximate area of bone involved with a thrombus-embolus formation (fixation point) in the main stem of the nutrient artery.

Figure 4 represents conditions when an embolus-thrombus formation occurs in the course of one of the main branches of the nutrient artery, close to the point of division. The disturbance of nutrition depends upon the degree of intraosseous clotting and upon the capabilities of the collateral circulation. The segment of bone tissue destroyed corresponds closely with these conditions. Involucrum formations follow also along similar lines and depend upon factors and processes outlined in the previous paragraph. In clinical surgery specimens are quite common in which a sequestrum removed at a subsequent operation represents a portion of the circumference of the bone.

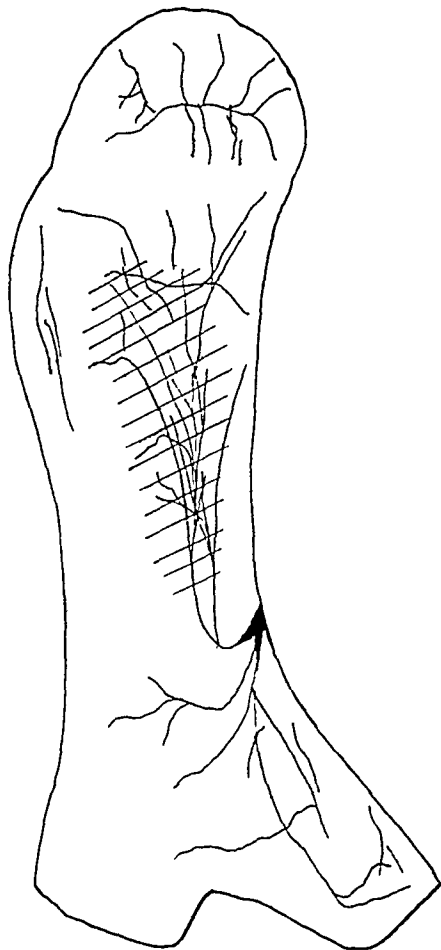


FIG 4.—Similar to Fig 3. The shaded area represents the approximate area of bone involved when the thrombus embolus formation (fixation point) is situated in one of the branches of the nutrient artery.

Figure 5 represents conditions when an embolus is arrested in a terminal branch of the intraosseous network. This variety represents the mechanism of formation of a chronic bone abscess. The arrested embolus is infected and an abscess forms around it. There can be no further spread of the process through the vascular channels of the bone because the plugged vessel is a terminal one. The spread of the abscess locally is comparatively small and is quickly limited as soon as hard bone is reached. Progress through the hard bone is very difficult and in a certain proportion only is the eroding process sufficient to open an avenue into the soft parts. In clinical surgery the evidences of this are found in an acute or chronic osteomyelitis with or without one or more skin sinuses in which the complicated sinus tract leads at one point into the interior of the bone into a cavity containing pus or granulation tissue or both. In the rest of the cases the abscess formed originally becomes localized and is bounded by a firm granulation membrane and the hard cortex of the bone. After a while the organisms in the interior of the abscess die and a sterile collection of pus results. In clinical surgery these form the chronic bone abscesses and depending on the relative time at which the abscess is opened, one may find a chronic bone abscess containing viable organisms or one which is bacteriologically sterile. These latter are the kind that have recently been studied from the therapeutic point of view by Brickner.

Figure 6 represents conditions when the embolus-thrombus formation occurs in one of the small vessels in the cortical portion of a part of the bone. An abundant collateral circulation both from the periosteal and nutrient artery systems limits the disturbance of nutrition to a minimum. The resulting sequestration is, therefore, comparatively small. Involucrum formation from the periosteum is not as abundant as with the other types owing to the lesser intensity and smaller spread of the process and depends for its existence upon causes similar to those previously described. Various grades of this variety exist depending upon the number of small vessels involved primarily and upon the possible spread of thrombosis in the neighboring vascular network.

The conditions just described are the typical varieties that one encounters in clinical practice. It must be remembered that many times the differentiations are not sharply demarcated, so that it is difficult to make the proper

## THE MECHANISM OF ACUTE OSTEOMYELITIS

classification The difficulty results from the fact that cases in one group frequently have characteristics of cases in the other group or groups and the atypical manifestations and pathology results from the fusion of the physical, anatomical and histological characteristics of more than one typical group

In experimental work it has been recognized that the ordinary form of osteomyelitis is a blood-borne infection and the many attempts to reproduce osteomyelitis artificially have made use of

some of the essentially known facts of general infection and of local fixation points. The usual method has consisted in introducing bacteria into the bone directly through an operative wound, or in introducing them through the blood stream by injecting a viable culture into a blood-vessel feeding a given bone. Up to the present time it has not been possible to reproduce a true osteomyelitis in this way. One of two things usually happens (a) either a severe general infection is produced and the animal promptly dies, or (b) the inoculations are followed by no demonstrable effect whatsoever. It has been recognized that success depends (a) upon employing an organism of the proper low virulence, and (b) upon preparing the local conditions properly. The essential difficulty has existed in the proper preparation of the local area in the bone so that the organisms could be attracted thereto, if that could be secured, the question of securing an organism of properly low virulence could, perhaps, more easily be accomplished. It seems to be correct to assume that this difficulty is an inherent one and exists because of the impossibility of reproducing artificially a



FIG 5 —Similar to Fig 3. The shaded area represents the thrombus-embolus formation (fixation point) in a terminal vessel near the avascular area. The result is a bone abscess of circumscribed extent.

fixation point by a thrombus-embolus formation as described in the preceding paragraphs. The artificial attempts always fail because of the following facts (1) The impossibility of producing successfully the proper grade of bacteriæmia. (2) The impossibility of properly preparing the local field for the embolus-thrombus formation, this depends upon the physics of the local circulation at any given moment, upon the presence of any local trauma as previously described, and upon the fact that even in actual disease the determination of the thrombus-embolus formation must necessarily be a matter of chance. (3) Failure results because at any given moment all factors must be in exact relation with one another for the experiment to succeed. The

attempts to reproduce osteomyelitis artificially by boring various kinds of holes in a bone and thereafter introducing bacteria of an artificially made low

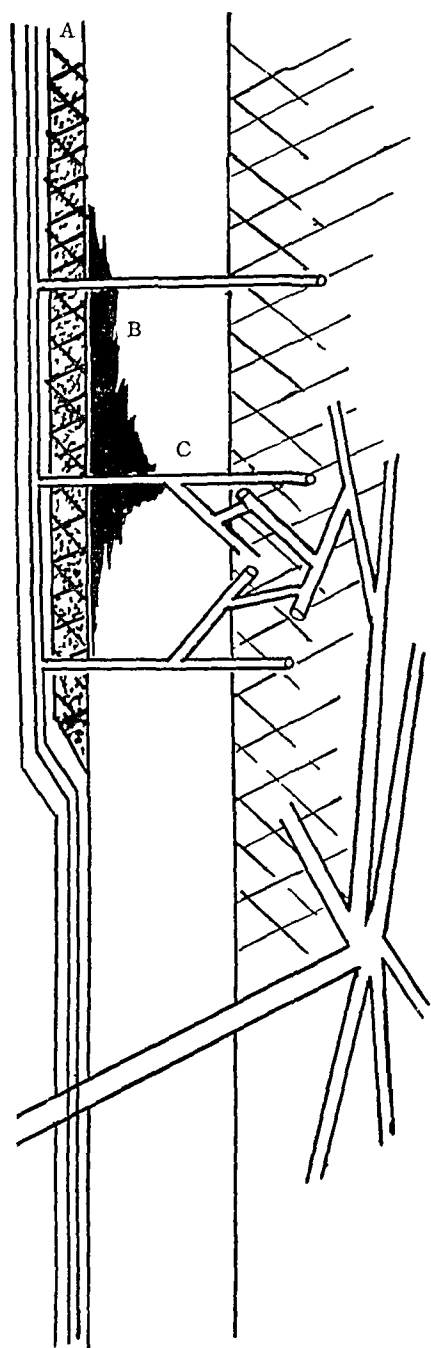


FIG 6—Diagrammatic representation of embolus thrombus formation in a small cortical vessel in the mechanism of acute osteomyelitis A Involucrum B Sequestrum C Approximate position of the thrombus embolus In this variety the direction of the blocking and the entry of the infection is from the bone side of the circulation and not from the periosteal circulation

virulence can only produce a form of osteomyelitis with which one meets naturally when a bone is infected from an exogenous source during a trauma, the percentage of "takes" in actual practice are very small and the "takes" in experimental investigations are even smaller because of those factors detailed above

The spread of vascular clotting under the influence of (1) the original embolus-thrombus formation or (2) of persisting infection in the clotted area is an important factor (1) in explaining certain primary characteristics of acute osteomyelitis, (2) in enabling a proper classification of the individual case, (3) in explaining certain obscure manifestations of this disease and (4) in properly presenting a sufficient mechanism for the apparent or actual spread of the primary lesion

The possibility of a spreading thrombus formation is corroborated by similar phenomena in the thrombosis of other vessels, notably in the vessels supplying the intestinal tract (superior or inferior mesenteric), one of the factors in the latter disease which makes thrombosis of either of these two vessels so fatal, is the proximity of the process to spread and involve other loops of intestine

An important characteristic of an acute osteomyelitis is the impossibility of determining clinically or even upon operative exposure the exact extent of the disease The physical basis for this exists in the manner and extent of the intraosseous vascular clotting, and of the disturbance of circulation and to the fact that, owing to the physical structure of the bone these changes are not visible at an early stage of the disease—i.e., at the time these cases are usually operated upon Further-

more, a certain amount of collateral circulation becomes established subsequently to the primary embolus-thrombus formation and its immediate

## THE MECHANISM OF ACUTE OSTEOMYELITIS

accompanying disturbance in the bone circulation so that tissue which might first be compromised can later be returned to a normal status, none of this primary or secondary change can be seen by the naked eye or demonstrated by the aid of some physical agent. Attempts have been made to make use of certain dyes by the intravenous use of which it was hoped it would be possible to delimit the involved area, none of these, however, proved successful or practical for reasons which are self-apparent. This disability has been the most powerful agent (1) in preventing a proper classification of the individual case upon anatomic grounds, and (2) in preventing a proper form of operation for acute osteomyelitis.

From clinical evidence it usually seems to appear that the amount of bone involved in any focus of osteomyelitis is many times much larger at the very beginning of the process than sometime later. The physical basis for this phenomenon lies in the relatively large primary involvement of the bone by the embolus-thrombus formation and especially by its accompanying disturbance of blood supply of the interior of the bone and in the secondary contraction of the area of bone tissue thus involved because of the development of collateral circulation. In many of the cases of acute osteomyelitis which one sees, the resultant residue of involvement becomes permanent and remains unchanged during the further course of events of that particular focus of osteomyelitis. The physical basis for this lies in the limitation of the infectious process to the intraosseous vascular area as just determined. In the large number of cases of acute osteomyelitis in which the process enlarges or involves other parts of the same bone, the spread of the process depends primarily upon physical changes in the intraosseous vascular clotting, and in the potentialities for disturbances of the circulation of the bone.

If the infection persist in a vascular clotted area, spreading of the clot occurs. I give the notes of a case of acute osteomyelitis in which this was very well illustrated.

CASE VI.—In a young girl an acute osteomyelitis developed in one ulna. The process seemed limited and a radical osteotomy was immediately done, the wound was then packed wide open. On the tenth day the packing was removed and the lips of the wound strapped together. Agglutination of the wound surfaces rapidly took place and during the succeeding fortnight the wound apparently healed with the exception of a small superficial sinus. Within a number of days, thereafter however, the wound became reddened and inflamed and an X-ray picture (Fig 7) showed that the process had apparently spread.

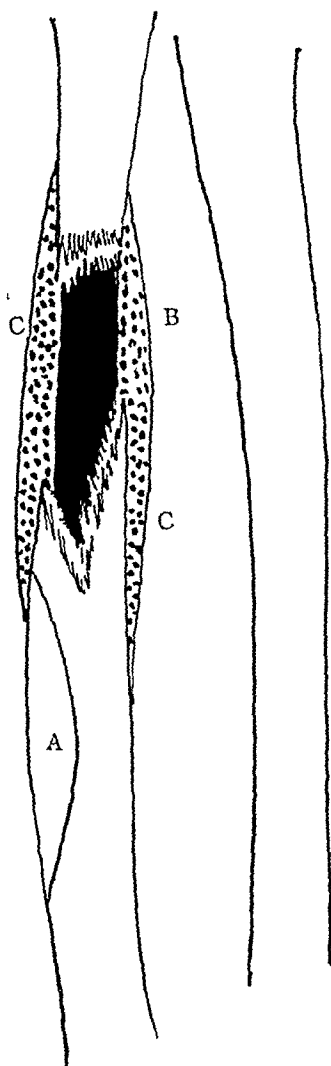


FIG 7.—Tracing of X-ray photograph of Case VI. A, Old osteotomy. B, New focus and sequestrum. C, Involucrum around new sequestrum.

On first sight it might appear from the roentgenographic evidence as if an entirely new focus had formed. But it seems that the proper explanation of this case lies in the spread of the original embolus-thrombus formation. The latter had probably spread in a retrograde fashion until a fairly large trunk of the nutrient artery had become involved in the thrombosis with the physical end result shown in the accompanying tracing (Fig 7) taken from the X-ray pictures. The compensatory involucrum formation is typical and is well shown. It is quite possible that much of the so-called traumatic-operative destruction of bony wound margins after osteotomy depends upon a similar mechanism.

Any increase in the extent of the intraosseous vascular clotting can occur in one of two ways. In the first of these, the clotting spreads along the vascular channels in the direction in which the blood current flows. Several possibilities follow. (1) A piece of the thrombus breaks off and lodges in a smaller vessel further along, the accompanying clinical manifestation is that of an acute exacerbation of the process which need not necessarily create alarm, or (2) a progressive thrombosis occurs along and in the direction of the vascular path, this practically always indicates a steady, slow progression of the infection along the thrombus. A peculiar form of osteomyelitis results which is characterized by a slow progressive involvement of the osseous tissue, clinically this is seen as a molecular necrosis of the bone tissue in the wound surfaces. Operation—the usual form practiced is a curettage of the bone—is followed by no checking of the process. In this form of osteomyelitis it is found, clinically, that Dakin's solution has no sterilizing effect and the reason for this is obvious. The only efficacious method for controlling this form of osteomyelitis is by a wide excision into healthy tissue.

In the second place clotting may extend along the vascular channels in the direction the reverse to that in which the blood flows, that is, in a retrograde fashion. (This seems to be a common occurrence in case of thrombophlebitis.) As soon as a branching of the blood-vessels is encountered the thrombotic process spreads along the branches either in the direction in which the blood current flows, in which event the course of events repeats those outlined in the previous paragraph, or the extension continues in a retrograde fashion. A number of possibilities follow. (1) If the sizes of the branching blood-vessels are very small, the character of the pathological process and of the corresponding clinical manifestations does not differ from that produced when the clotting spreads along the vessels peripherally as previously described. (2) If a large vessel or a main branch of the nutrient artery is encountered and the latter becomes involved in the clotted area, the manifestations may resemble (a) an acute exacerbation of the process, or (b) those accompanying the development of a new focus. A bacteraemia or general blood infection may mark the development of either of these two clinical pictures and may or may not be an entirely new phenomenon. A

## THE MECHANISM OF ACUTE OSTEOMYELITIS

small focus may in this way be transformed into a large one occupying a considerable, if not the major part of the bone (3) It is possible for the clotting to extend backward and involve the main nutrient vessel of the bone The clinical picture becomes very alarming indeed under such circumstances I give the notes of such a case

CASE VII—A young girl was admitted with an acute osteomyelitis in one tibia of very circumscribed extent and with moderate clinical manifestations A subperiosteal abscess was demonstrated Sometime later there was an alarming increase in the clinical symptoms both general and in those referred to the local area It was shown that the whole bone had become involved Undoubtedly in this case the nutrient artery had become involved secondarily A bacteriæmia was not present in this case

More commonly, however, a general blood infection does develop with this extreme spread of the process and it is apt to be of a highly desperate character This explains the opinion sometimes heard that osteomyelitis should be regarded as something very urgently in need of surgical care in order to prevent any such dangerous development The opinion is undoubtedly fundamentally correct and while under ordinary circumstances this possibility is an uncommon one, the thought of it should, nevertheless, be constantly borne in mind and should influence our course of treatment in every case of acute osteomyelitis

The likelihood of any of these various forms of spread of the osteomyelitic process is not limited to the times before operation is done, nor to the early stages of the pathological process The spread of the thrombosis may occur at any time either before or after operation or between successive operations, however far they may be removed from one another in point of time Probably this characteristic of osteomyelitis explains the greater number of so-called recurrences, if not all of them The widely held belief that operative manipulation in bone tissue is likely to spread the osteomyelitis focus is explainable also on the basis of a spreading thrombosis in the bone tissue capillaries

The likelihood of secondary emboli forming under such conditions of vascular thrombosis in acute osteomyelitis is, of course, very strong It explains (1) the formation of multiple foci in the same bone or in different bones, and (2) the exacerbations or recrudescences that one encounters during the course of an acute osteomyelitis The number of possible ways in which the primary focus could spread whether by progressive thrombosis, or by embolus, is, theoretically, of an infinite number and in actual practice any form of spread of the pathological process in acute osteomyelitis is fully explainable on this basis

*Acute Osteomyelitis in Irregular and Flat Bones*—The biological phenomena of osteomyelitis in bones of a different shape and interior structure than a long bone are essentially the same as those in a typical long bone Certain differences which are discernible and are common knowledge are directly attributable to the differences of structure in the vascular network



and, to a minor degree, to the differences in the architecture of the individual bone, especially the absence of a medullary cavity. There are two broad groups of this anatomical variety of osteomyelitis—that of the irregularly shaped bone—the vertebra, or the maxillæ, for instance—and that of the flat bones—the bones of the skull. Both of these varieties of bone are devoid of any medullary cavity.

In an irregularly shaped bone the process is exactly similar to that of a long bone, if one leave out of consideration any medullary cavity. It is practically the same as if the process were limited to the cortical and cancellous structure of a long bone. When the nutrient artery is involved practically the whole bone necroses. It is very rare to find an abscess, resembling the acute or chronic abscesses of long bones, in an irregularly shaped bone, the subperiosteal abscess type of osteomyelitis is much more common. Osteomyelitis of irregular bones, especially the parts of the spinal column, are particularly prone to be associated with a high grade of infection. Frequently the source of the general infection is obscure.

An instructive case, taken from the literature (Raimann Med Klinik, 1924, vol xx, p 670), is the following:

CASE VIII—An eleven year-old patient developed a severe acute illness the dominant symptom of which was pain in the spine. The patient died of "pyemia." The post-mortem examination showed an osteomyelitis of the tenth dorsal vertebra with a large prevertebral abscess. This was apparently a subperiosteal abscess.

The flat bones are structures derived exclusively from periosteal formation and from two opposing periosteal surfaces. Practically speaking, the blood supply of the bone is a double periosteal vascular network. The nutrient artery circulation is negligible. The form of osteomyelitis which develops is determined by the physical characteristics of the vascular network, periosteal and subperiosteal forms of inflammation are the rule. A dominant characteristic of osteomyelitis of a flat bone is that its development immediately destroys the osteoblasts that are present. This explains the absence of any new bone formation, the extreme of this occurs when a defect occurs in the entire thickness of the skull bone, the defect remains permanently. Under ordinary circumstances the integrity of the bone is preserved by the physical fact of the double periosteal origin of the bone, circulation and repair is maintained from the opposing surface to that in which the inflammation is seated, and, as in other bones, the amount of destruction is limited to a superficial sequestration.

Group III—A very important group of cases of osteomyelitis is made up of cases in which infection is first introduced from without by contiguity of structure or during a trauma, and is later associated with a general blood infection.

The best example of the former is the form of osteomyelitis of the mastoid process which follows infection of the middle ear. The process includes an infection of the middle ear which spreads to the lining mucous membrane of

the cells of the mastoid in all of their ramifications, with a secondary involvement of the bone itself. Changes in the small blood-vessels of the bone—collectively, the so-called osteo-phlebitis of Koerner—must be assumed in rare cases to explain the occurrence of a metastatic focus, when the large lateral sinuses are normal. As the process develops the wall of the lateral sinus becomes involved in turn, either by direct contiguity or by way of communicating blood channels (extension of Koerner type) and thrombosis occurs, the thrombus being either parietal or occluding. The studies of Libman and his co-workers have shown that under such conditions bacteria may be cultivated from the blood stream. The characteristics of such a blood infection include (1) an infected blood clot, which feeds into the circulating blood a comparatively small number of organisms, as demonstrated by the number of colonies which can be cultivated by the plate method, (2) the development of secondary metastatic deposits in various parts of the body, notably in the bones and in the joints, (3) the possibility of completely curing the condition by eradication of the disease in the mastoid process and by prevention of the infected blood clot from feeding organisms into the general blood circulation by ligation of the jugular vein on the cardiac side of the clot and complete drainage of the lateral sinus with excochleation of the infected clot. The last factor depends for its efficiency, and is based upon an early recognition of the basic condition and upon prompt surgical intervention. There are many instances in which after operation a disappearance of the blood infection does not take place, or reappears after it had once disappeared, these exceptions are due to primary or secondary involvement of the petrosal sinuses in the thrombotic process, or, possibly to association with the Koerner type of osteophlebitis.

The usual bacteriological findings include staphylococci, streptococci, pneumococci and atypical forms related to them.

Gunshot and military wounds of bones form a large group in which general blood infection may appear subsequently as part of the clinical picture. The process in the bone is that typical of the ordinary forms of osteomyelitis, especially that complicating fracture and the characteristics of the pathological picture depend on the kind of infecting organism, its virulence and the dose of organisms delivered with the trauma. The organisms found belong to the broad group customarily found in the intestinal canal, the colon group and gas-producing organisms predominate. This is due to the filthy conditions of military life and the fact that so frequently pieces of clothing are carried into the wound in front of the projectile.

Thrombosis of the bone vessels form a prominent part of the pathological picture and from these blood infections appear. In military wounds general blood infection is frequent. The important point to remember is that when they occur, they are consequences and not primary factors in the bone disease, even though the shortness of the time interval might mislead one.

Gunshot and military wounds of bones in which osteomyelitis subsequently appears form a subgroup of the large group of infected compound fractures occurring under any and all conditions in which contamination from the outside becomes rooted as an infection of bone tissue (osteomyelitis). In civil life, too, it occasionally happens that an ordinary infected fracture subsequently becomes complicated by the presence of a bacteraemia or general blood infection. In civil life such complicating blood infection of compound infected fractures are usually of the most severe kind and fatalities are the rule and not the exception. Under military conditions such complicating general blood infections are also of the most severe kind and with few exceptions they are fatal.

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting Held April 8, 1925*

The Vice-president, DR WALTON MARTIN, in the Chair

## PARTIAL GASTRECTOMY FOR CARCINOMA OF THE STOMACH

DR CHARLES H PECK presented a man, sixty-two years of age, who was admitted to Roosevelt Hospital, December 11, 1924. For two months only before admission he had suffered from belching of gas, sour stomach, eructations, loss of appetite, loss of weight. There was no actual pain. Debility and loss of strength marked. Had vomited only twice prior to admission. Bowels constipated. Complaints of hemorrhoids.

His previous history was unimportant, except that five years ago he had a cyst of the thyroid removed by Dr C N Dowd.

On admission his X-ray plates showed a gross filling defect in the antrum of the stomach with a 50 per cent gastric residue at six hours.

At operation performed December 18, 1924, the stomach was found to contain a very large mass occupying the lesser curvature from the pylorus to within an inch of the cardia. There was a very large gland at the upper end of the lesser curvature. There were no nodules in the liver, no definite adhesions to the pancreas, no secondary growth found anywhere. Fully three-fourths of the entire stomach was removed, and an anterior gastro-jejunal anastomosis made, with the jejunum about twelve inches from its origin. The reaction was very moderate, and he made an uninterrupted recovery, after a transfusion done on the second day. He was discharged March 21, when he had gained seven pounds in weight. He was eating light diet without distress, gaining strength steadily. General condition excellent. He is feeling perfectly well at the present time. Sections of the tumor showed colloid carcinoma of the stomach with metastasis to the glands of the greater and lesser curvatures.

DR CHARLES GORDON HEYD remarked upon the choice of the anterior Polya in preference to the posterior. In his experience the retrocolic operation had been associated in one case with acute intestinal obstruction from retraction of the stomach and jejunum upward and he thought this complication was obviated by the anterior method.

DR HENRY H M LYLE said that a number of years ago he did a posterior Polya and the patient died. At autopsy it was found that the suture line had held perfectly but that the patient had died from a high ileus with enormous dilatation of the remaining portion of the stomach. Since this happening when he does a Polya he employs the anterior with an entero-enterostomy.

DR NATHAN W GREEN considered that the post-operative improvement in this case only four months since the operation, showed that the condition one had to deal with in cancer of the stomach was frequently divided into two parts: one due to mechanical obstruction, and the other due to toxæmia. On removal of the growth the toxæmia appeared to have been

removed also. That might be the chief reason why the patient seemed to have been benefited so much more than by the simple correction of the mechanical obstruction by a gastro-enterostomy.

It would seem justifiable therefore to make more frequent attempts to remove these growths on the border line of operability, because of the improvement after the removal of the toxic absorption, even if one could not in many cases hope for more than a few months' remission.

DR EDWIN BEER said that it was astonishing how large a number of carcinomas of the stomach in this community reach the operating table in an inoperable condition. It was difficult to say where the fault lay. Apparently, however, the condition is recognized too late in the great majority of cases. In this patient presented by Doctor Peck, in which he had obtained a brilliant post-operative result, the disease was most extensive so that the operator had hesitated before making the very wide resection. It would be of interest to know how often operable cases of carcinoma of the stomach are seen by members of this Society. In his own service at Bellevue Hospital less than ten per cent of the cases reach the operating room in a condition where resection might be justified. This is a rather serious situation when one considers the results that have been reported in this disease from some of the clinics of the Middle West.

DR GEORGE WOOLSEY said that in one case where he did an anterior operation he was obliged later to make an entero-anastomosis. He saw a patient recently in which the growth had not been so extensive as in Doctor Peck's case, but which had required an extensive operation. He did not believe when he operated in 1913 (eleven and one-quarter years ago) that the outcome would be favorable, but when seen a few weeks ago the man had been well up to last November, but he now has gall-bladder trouble. The X-ray shows the stomach has been removed to the line of the vertical portion of the lesser curvature and still further on the greater curvature. The operation was a Billroth II and the remains of the stomach appear normal in the X-ray.

DR HERMANN FISCHER said that during the last five or six years the antero-colic Polya-Balfour modification of the Billroth II had been his operation of choice in resections of the stomach for ulcer or carcinoma. His experience has been uniformly satisfactory. He prefers the Polya to any other method where he cannot do the Billroth I.

DR ALLEN O WHIPPLE mentioned the case of a patient who four years ago had a large growth involving the lesser curvature. The lymph-nodes extended so near the cardia that it did not seem as if there would be room to apply clamps. An anterior Polya was done and the man continued well for forty-seven months. Suddenly six weeks after a follow-up visit, he developed symptoms of epigastric distress and had a definite recurrence in a palpable mass. During the four years he had remained well and had returned to work.

DOCTOR PECK, in closing the discussion, said that he did an anterior Polya instead of a posterior because it was the only operation suitable as the

## INTESTINAL OBSTRUCTION AFTER APPENDECTOMY

growth was so high. He has done a moderate number of posterior Polyas and when resection can be done further down he thinks it is a suitable operation. He had not had any post-operative obstructions in his cases. He had not presented this case as a cure but as an extensive resection in which he felt it might well have been an error in judgment to attempt to resect at all. The man has been given a little extension of life and comfort, and even though it recur within a year it has been worth while. In answer to Doctor Beer, Doctor Peck said he saw few cases suitable for resection. In one of his early cases of carcinoma the man lived fourteen years after resection and died at the age of eighty of prostatic disease. There are not many such cases. Shortly after this operation was done, another man, seventy-four years of age, was operated on for a growth as extensive as this, reluctantly and only when strongly urged by the patient and his family, and, except for an operative accident, he might have recovered. The resection was fully as extensive as in the case shown this evening. But there was one difference, the carcinoma had perforated against the body of the pancreas and there was quite a wound in the body of the pancreas on removal of the growth. This constituted a serious accident and, although the man went for nine days and had advanced to articles of soft diet, he suddenly developed a secondary hemorrhage from the pancreatic vessels and died. The actual resection can be done safely in some of these extensive cases, and one can occasionally get sufficient benefit to make such an operation worth while.

## INTESTINAL OBSTRUCTION AFTER APPENDECTOMY

DR JOHN GERSTER presented four cases of intestinal obstruction following appendectomy from a few weeks' standing to several years after operation.

S. W., a boy of thirteen years, had appendectomy for acute gangrenous appendicitis, March 9, 1923. No drainage. Uneventful convalescence. Discharged March 20, 1923. On April 25, 1923, seven weeks later, was admitted to Mt. Sinai Hospital for acute intestinal obstruction of 24 hours' duration. Through a right paramedian incision several bands of adhesions binding together the lower portions of the ileum were divided. The obstruction was relieved. The contracted intestine below the point of obstruction remained contracted for some time after separation of the adhesions. The boy made an uneventful recovery, being discharged May 8, 1923.

H. C., a boy of fifteen, had appendectomy with drainage for acute gangrenous appendicitis and peritonitis, March 7, 1917. Was discharged March 24 and admitted a few days later with a volvulus of the terminal part of the ileum due to post-operative adhesions. The volvulus was reduced and adhesions divided. All mesenteric glands were enlarged and there was much free fluid in the peritoneal cavity. Six years later, August 11, 1923, he was admitted to Mount Sinai Hospital with intestinal obstruction of four days' standing. Upon opening the abdomen through the original scar, a dilated loop of gut densely adherent to the scar was nicked. This wound was repaired. Several loops of small intestine entangled in adhesions were freed, the obstruction was relieved and the patient made an uneventful recovery, being discharged August 26, fifteen days later.

Louis K., a man of twenty-eight years. In October, 1921, he was operated on for perforated gangrenous appendicitis with abscess. A fecal fistula

arm. She reported thereafter at regular intervals, remaining well. In 1920 she omitted to present herself. When she called in the spring of 1921 she had a swelling over the left first rib involving the clavicle. It was a regional, inoperable recurrence. The patient was referred to the Radiologic Department of St. Luke's Hospital, where Dr. Francis Carter Wood took care of her. She made her visits regularly, and carefully carried out every order given to her. In the summer of 1923 she suddenly developed an acute erysipeloid with an eczema-like eruption of the skin. The skin of the entire region gradually became firmly infiltrated and has remained in this condition ever since. Gradually, during one and one-half years, the ulceration over the first rib closed, she never developed supraclavicular gland involvement. At present there is no intra-abdominal nor intrathoracic metastasis. For the present the patient is apparently again cured. This is a rather unique case, inasmuch as the bone, having been fully involved, with a malignant ulceration present, has healed under X-ray treatment.

How can one explain such an occurrence? Cancer cells must evidently be dormant in the tissues, perhaps from the time before the operation, until something awakens them and they then resume their activity. But what does, what can awaken them? It is totally mystifying unless one agrees with the speaker and others that the endocrine system plays a great rôle and is responsible for the occurrence, at least in part.

As to the five-year period of freedom from recurrence accepted as denoting a "cure," it may be wise to change this and speak only of the number of years in which new manifestations of the original disease have been prevented. Still, almost every surgeon has seen freedom from cancer in some of his patients for a long time after operation. Personally, Doctor Meyer had observed such long freedom from recurrence in a number of cases of radical operation for cancer of the breast in some instances for thirty years or more, so that after all one had the right to speak of a "cure" in cancer. It would seem that the virulence, the degree of malignancy, is the deciding factor.

#### OPERATIVE TREATMENT FOR ARTHRITIS DEFORMANS OF THE HIP

DR. ROYAL WHITMAN read a paper with the above title, for which see *ANNALS OF SURGERY*, vol. lxxx1, p. 1108, June, 1925.

DOCTOR WHITMAN presented two patients to illustrate his paper. The first, a woman of forty-eight years of age, had suffered from pain and increasing disability for twelve years and when first seen used crutches. The operation was performed November 12, 1923. She now attends to her household duties, has practically no pain, and walks with a scarcely perceptible limp.

The second patient, a man fifty-eight years of age, was operated on November 19, 1923. His disease of several years' duration had become extremely painful and disabling. He said it sometimes required ten minutes to rise from a chair because of the extreme pain and stiffness in the joint. His pain has been completely relieved. There is but slight limp and he states that he can walk ten miles without ill effect.

In reply to questions, Doctor Whitman said that the removal of osteophytes about the margin of the acetabulum was a question of judgment since in some instances in which there was considerable destruction of the upper margin they increased stability.

## BLEEDING DUODENAL ULCERS

There was never in these cases ankylosis as he understood the meaning of the term, although the motion might be very limited by destructive changes and by the formation of osteophytes. The object of the reconstruction operation was to reduce the size of the bearing surface of the femur, and by abducting the limb to thrust it deeply into the acetabulum where the cartilage was in fairly normal condition.

The reconstruction operation was designed for the better class of patients as regards age and local condition. In cases of extreme deformity with upward displacement the pain, dependent upon mutual friction, was much less and the patients having become accustomed to the disability would rarely consent to operative treatment.

---

*Stated Meeting Held April 22, 1925*

The President, DR. EUGENE H. POOL, in the Chair

### PENETRATING GASTRIC ULCER PARTIAL GASTRECTOMY

DR. RICHARD LEWISOHN presented a man, fifty years old, who was admitted to Mount Sinai Hospital, October 21, 1923, with the following history. He had an attack of epigastric pain three years ago. He was then symptom-free until three weeks prior to his admission, when symptoms recurred. He had severe pains one hour after meals, lasting about an hour. These pains were relieved by taking food. Ewald free HCl 60, total acidity 85. X-ray examination showed a large penetration situated on the lesser curvature at the reentrant angle, with a marked delay in the motility of the stomach. The roentgenologist stated that "in view of the size of the defect and the age of the patient, a new growth must be thought of."

Operation revealed a large ulcer situated at the posterior wall and densely adherent to the pancreas. On account of the extensive adhesions which reached very high up, the usual procedure was modified, and the resection was started by division of the duodenum. The duodenal stump was closed in three layers. It was then possible to divide the posterior adhesions under the guidance of the eyes, and thus avoid injuring the median colic vessels. The base of the ulcer was left on the pancreas and about two-thirds of the stomach was resected. The gastric end was closed in three layers and a retrocolic button gastro-enterostomy was performed. The specimen showed a large ulcer, about 6 cm. in diameter. The patient made an uneventful recovery, and left the hospital, November 17, 1923.

Microscopic examination showed a callous ulcer. The button was passed December 30. The patient has been in perfect health since the operation. He has gained about forty pounds. Ewald test meal, taken last week, shows free HCl, 0, total acidity, 15. X-ray examination shows normal motility of the stomach.

DOCTOR LEWISOHN stated that the rational surgical treatment for gastric ulcers was undoubtedly partial or subtotal gastrectomy, the only method which assured a permanent cure for the patient.

### BLEEDING DUODENAL ULCERS PARTIAL GASTRECTOMY

DOCTOR LEWISOHN showed two patients who had suffered from repeated gastric hemorrhages and were cured by partial gastrectomy.

CASE I—A. K., thirty-three years old, was admitted to Mount Sinai



Hospital, complaining of epigastric pains for seven years. Four months before his admission he noticed tarry stools. Three months ago he fainted on the street, and was taken to another hospital, where he stayed six weeks. He vomited coffee-brown material during his stay at this hospital, and his anaemia was so severe that a blood transfusion was performed. In the last few weeks prior to his admission to Mount Sinai Hospital, he felt very weak and complained of epigastric distress. On admission the hæmoglobin was 84 per cent, the stool was negative for blood. Ewald free HCl 60, total acidity 85. X-ray examination showed an annular constriction about three quarters of an inch from the pylorus, without residue. Diagnosis: duodenal ulcer.

An exploratory laparotomy July 30, 1924 (Doctor Lewisohn), failed to show evidence of an ulcer either in the stomach or duodenum. The stomach was incised and a finger introduced into the duodenum. The mucosa appeared perfectly normal. The gastrotomy opening was closed. A small varix in the liver suggested the possibility of oesophageal varices as the source of the gastric hemorrhages.

The patient made an uneventful operative recovery and left the hospital August 16.

He was readmitted to the Medical Service two weeks later, on account of hemorrhages which recurred the day previous to his readmission. In the afternoon following his admission the pulse went up to 160 and became almost imperceptible. The skin was cold and clammy. He vomited one quart of old blood. He got over the acute attack but continued to lose small amounts of blood during the next few weeks. He required another blood transfusion, as his hæmoglobin had gone down to 40. Another X-ray examination (October 17) showed the same findings as before. He was transferred to the Surgical Service and re-operated November 5. His hæmoglobin at the time of operation was 50.

The operation was performed without general anaesthesia. After careful infiltration of the abdominal wall with  $\frac{1}{2}$  per cent novocain, the peritoneal cavity was entered. Extensive adhesions were separated and the round ligament was divided. A small flat induration was felt on the superior wall of the duodenum, between the first and second part of the duodenum. Many retrogastric adhesions were encountered. A partial gastrectomy with Hofmeister anastomosis was performed. The specimen showed a flat duodenal ulcer about the size of the finger nail of the fifth finger. Microscopic examination: callous ulcer.

The patient made an uneventful recovery and has been free from gastric symptoms since the operation. Ewald test-meal shows free HCl, 10, total acidity, 25. X-ray examination shows a normal stoma and no delay in motility.

CASE II—O. L., twenty-seven years old, was admitted to Mount Sinai Hospital, November 12, 1924. He had suffered from epigastric distress and gaseous eructations for four years. He had noticed tarry stools on several occasions. An exploratory laparotomy was performed in another hospital three years before, through an upper abdominal incision. The appendix was removed. The pains had grown worse since the operation and were relieved by taking food and bicarbonate of soda. He vomited occasionally. During the last two years he had lost thirty-five pounds, and had repeated hemorrhages (tarry stools). No hæmatemesis.

Upon his admission to Mount Sinai he presented a moderate degree of anaemia, and a ventral hernia as a result of the previous operation. X-ray examination showed a duodenal ulcer.

## BLEEDING DUODENAL ULCERS

The operation was performed November 2, 1924, under gas-oxygen anaesthesia. The scar was excised, and dense adhesions were divided. A flat ulcer was felt in the first part of the duodenum, with a slight oedema around the ulcer. A partial gastrectomy was performed. The vessels were ligated, the stomach was cut across, just above the reentrant angle. The duodenum was divided between the first and second parts of the duodenum, and was closed in three layers. At this point the patient stopped breathing, and artificial respiration had to be resorted to. In order to finish the operation as rapidly as possible, the cut end of the stomach was closed in its entirety, and a button gastro-enterostomy was performed. The ventral hernia was then repaired, and the patient returned to the ward. Microscopic examination duodenal ulcer.

During the first thirty-six hours convalescence was very stormy. The patient vomited some blood, and his blood-pressure fell rapidly. A transfusion of citrated blood (500 cm.) was given five hours after operation. The condition of the patient looked very hopeless the next morning. However, he rallied during the next twenty-four hours, and made an uneventful recovery, aside from a left parotitis, which subsided automatically.

He is now perfectly well. X-ray pictures taken in February, 1925, show normal conditions. The Ewald test-meal, taken upon his discharge, showed free HCl 15, total acidity 32. Reexamination in April showed free HCl 0 total acidity 25.

DOCTOR LEWISOHN stated that he presented these two patients before the Society in order to emphasize two points. (1) Careful palpation of the duodenum, even with the aid of a gastrotomy, may fail to reveal a lesion, in spite of the fact that an ulcer is present. These ulcers have a typical life cycle. They flare up and subside at different intervals. At the time of the primary operations these ulcers had healed temporarily, and the fine scars evaded detection. A few weeks later the ulcers were again active, and caused serious hemorrhages.

(2) Partial gastrectomy presents the only method of permanent and radical cure of bleeding duodenal ulcers. It is not advisable to operate at the time of an active and profuse hemorrhage, as we could then only resort to palliative operations (gastro-enterostomy, etc.), methods which fail to cure the ulcer and to remove the danger of recurrent hemorrhages. These patients should be subjected to a partial gastrectomy after the acute symptoms have subsided, and before a repetition of the hemorrhage may cause a fatal outcome.

DR JOHN A. HARTWELL said that he recently had a case in Bellevue that was almost a duplicate of Doctor Lewisohn's first presentation. The interesting point was that instead of doing a posterior Billroth II, he did an anterior Polya. After the operation he found that the stomach had dropped so far to the left side that it had passed over the splenic flexure, an ideal position for proper drainage of the stomach.

The jejunum continued in a straight line with the transverse duodenum, the lesser curvature was in contact with the proximal end of the jejunal stoma and the greater curvature with its distal end. Hence there seemed to be no possibility of viscous vomiting and no entero-enterostomy was done. The convalescence was without untoward incident and no vomiting has

occurred since. It would thus seem that when the lesser curvature is divided high up, the swing of the stomach is such that an antecolic Polya is an ideal method of operation.

DR HERMANN FISCHER mentioned a case in which the patient not only gave the typical history of a duodenal ulcer, but in which the roentgenologist, Doctor Stewart, had made a positive diagnosis of duodenal ulcer. On opening the abdomen, stomach and duodenum and gall-bladder were perfectly normal on inspection and palpation. No adhesions anywhere. On the strength of the positive X-ray diagnosis an incision was made into the stomach close to the pylorus. A finger was inserted into the duodenum and the inside of the gut carefully palpated down to the papilla. No anomalies could be detected. Not satisfied with the negative findings, the speaker introduced a sigmoidoscope and a careful search was made without finding anything abnormal. The incision into the stomach was thereafter closed and as there was nothing further to do, the abdominal incision was sutured. The patient left the hospital after ten days, but returned four weeks later complaining of the same symptoms.

Several months later he was operated upon in the Presbyterian Hospital by Doctor St. John, who found the ulcer, excised it, and performed a short-looped iso-peristaltic gastro-jejunostomy.

This experience shows that a small ulcer can easily be overlooked, and it seems the best policy in such doubtful cases is to open the duodenum and inspect it directly.

DR DE WITT STETTEN said that he had had an experience similar to that of Doctor Fischer in overlooking an ulcer of the duodenum even when a pre-operative diagnosis of that condition had been made and the ulcer had been specifically sought for at operation. He cited a case in which the patient, a man fifty-four years of age, had suffered severe epigastric pain, rather characteristic as regards type and relation to meals of duodenal ulceration. X-ray examination confirmed this impression. There had been no hemorrhage. At operation a much diseased thickened gall-bladder was found to which the omentum was densely adherent. Careful palpation revealed no evidence of ulceration in the stomach, pylorus or duodenum. On the assumption that the gall-bladder was responsible for the patient's symptoms, a cholecystectomy was done. The patient improved greatly after operation and for a time was free from pain so that it was thought he had been cured by the removal of the diseased gall-bladder. About two months after operation Doctor Stetten was called to see the patient because of a severe gastric and intestinal hemorrhage from which he recovered. About eight months after this hemorrhage he was operated on at the Mt. Sinai Hospital and a large ulcer of the duodenum adherent to the pancreas was found. Doctor Stetten is also of the opinion that in questionable cases where palpation is inconclusive the stomach or duodenum should be deliberately opened to verify or disprove the presence of ulceration.

## HÆMOLYTIC STREPTOCOCCUS GANGRENE OF ARM

### FRACTURE OF THE NECK OF THE HUMERUS

DR SETH M MILLIKEN presented a woman, sixty-one years of age, who was admitted to the Reconstruction Hospital, January 26, 1925. Three days before admission she slipped on the ice and fell with her right arm abducted. At the time of admission she was carrying the right arm in a sling and unable to move the right shoulder, which was swollen and tender. There was no palpable deformity but a good deal of subcutaneous hemorrhage.

The arm was put up in abduction with skin traction on a Blake board and Balkan frame. The arm was gradually abducted to an angle of about 95 degrees. This position was maintained for fifteen days, the patient being quite comfortable. Voluntary motion was encouraged on the twenty-second day. The traction was removed on the twenty-fifth day and patient thereafter encouraged to use arm in all directions. She was discharged with good function February 28.

When seen March 30 she showed full function except for limitation in external rotation. Physiotherapy has been continued twice a week during the last month. The X-ray showed an oblique fracture at the junction of shaft and head of right humerus with impaction and slight inward rotation of the head of the bone.

DOCTOR MILLIKEN said that he had presented the patient to show the advantages of the traction method. She had full function at the end of seven weeks.

DR ROYAL WHILMAN said that the disability after injury to the shoulder was almost invariably due to restriction of abduction and outward rotation. Complete abduction with outward rotation was therefore the attitude of election during the primary period of repair, the means employed to assure it being of less importance.

### HÆMOLYTIC STREPTOCOCCUS GANGRENE OF ARM AND FOREARM

DR HENRY H M LYLE presented a man who entered St. Luke's Hospital, March 15, 1924, with a diagnosis of superficial gangrene of the arm. He was profoundly septic and presented an extensive superficial gangrenous inflammation of the right arm. The inflammation involved the flexor surface of the arm from the hand to within one inch of the axilla and was chiefly confined to the subcutaneous and fascial tissues. The accompanying illustrations show the nature and extent of the lesion (Fig. 1).

Operation, March 15, 1924. Complete débridement of all the involved tissues with implantation of Carrel tubes.

The patient was in such a desperate condition that it was thought to be advisable to operate without any general anæsthetic, local anæsthesia could not be employed on account of the extent and conditions present. Experience in France had shown that such cases were not very sensitive, due to the fact that the superficial sensory nerves were destroyed or their conductivity diminished by the inflammation. The whole right arm was swollen to about two and a half times its normal size. The hand was very cedematous. The whole flexor surface of the arm was involved in a process which seemed to have caused necrosis and sloughing of the skin, superficial fat and some of the fascia. Flaps of skin were undermined with pussy material suggestive of carbuncle. The intermuscular fascial septa were in some places eaten away and pus exuded from between the muscles. The skin was red and somewhat macerated. Skin on shoulder and back was puffy and red.

*Operative Procedure*—Without anæsthetic, sloughs were cut away from the flexor surface of the arm. Little strips of relatively uninvolved skin were severed and undermining slough removed. Pus pockets between the muscles were opened and the whole raw area was washed with peroxide and Dakin's solution. Four Dakin's tubes were applied under the flaps of skin and between the muscular septa. Posterior part of the arm was not treated, as it could not be definitely ascertained whether or not it was involved in the sloughing process.

These cases were not infrequently encountered in the fall of 1916 and their prevalence in some sections were largely due to the unhygienic conditions following the battle of the Somme. In the last year he had had three similar

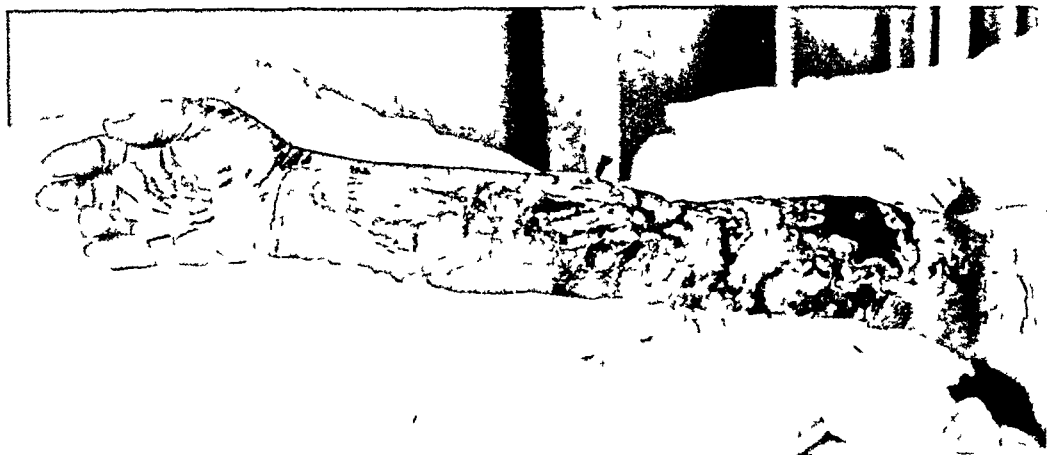


FIG 1—Hæmolytic streptococcus gangrene. March 15, 1924. Point of entrance of infection, tip of little finger.

cases in his service at St. Luke's Hospital, one late case which involved the entire leg required an amputation just below the hip to save his life, another involving the penis and scrotum died.

Meleney believes that the characteristic lesions are caused by a special strain of hæmolytic streptococcus which possesses an active lipolytic ferment.

The best plan of treatment is an early thorough debridement of the involved superficial structures, a sterilization of the wound by the Carrel methods, and prompt employment of Thiersch skin grafts.

An excellent article on this subject has been written by Meleney, "Hæmolytic Streptococcus Gangrene," *Arch. of Surg.* vol. 18, No. 2, Sept. 24, p. 317.

DR. FRANK MELENEY (by invitation) said that the case presented a very interesting condition which is apparently rare in this country but rather common among the Chinese. During the last four years he has seen about 35 cases in the Peking Union Medical College Hospital in Peking, China. The lesion occurs most often on the extremities, but it may develop on any part of the body surface. He has seen it affecting the scrotum and penis, the abdominal wall, the chest wall, the breast, the neck and the face. Recently a Chinese patient has entered the Presbyterian Hospital with this lesion on the scalp. Apparently it is a clear-cut clinical entity. It starts from any small break in the skin and spreads with alarming rapidity in the first two days.

## ARTERIOVENOUS ANEURISM

Then it causes an extensive necrosis of the subcutaneous tissues and seems to localize. Secondly, but with considerable rapidity, there is death of part of the overlying skin. It is essentially a superficial infection and does not invade muscle or bone unless the original injury involves those tissues. Most of the cases recover following extensive incisions and removal of the gangrenous tissue. One would suspect the presence of anaerobic organisms, but they are not found in this lesion. The only organism which is constantly present is the hæmolytic streptococcus which is found in pure culture in most of the cases. The lesion differs from the usual types of streptococcus infection by destroying a large mass of tissue and by tending to localize after its

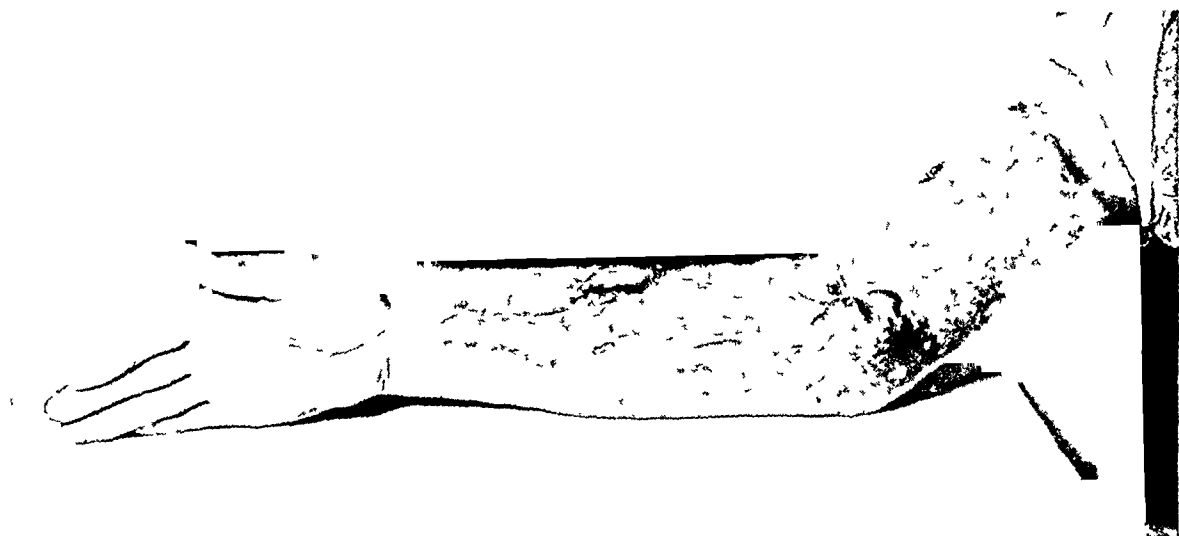


FIG. 2.—The condition of hand and arm April 27, 1924. Result from débridement, Carrel treatment and Theirsch skin grafting.

initial rapid spread. This must be due either to some peculiar biologic activity on the part of the organism or to a peculiar lack of local resistance on the part of the patient. Efforts have been made to determine whether or not the organisms recovered from this type of case had some special characteristics which would classify them in a special biologic group. The ordinary cultural tests have revealed nothing. Tests made to determine their lipolytic activity have failed to show any strongly active lipolytic ferment which might explain their localization in the subcutaneous fat. Agglutination experiments so far have not proved satisfactory but further efforts are being made in this direction. If cases are occurring in this city from time to time, Doctor Meleney said that he would like very much to obtain some cultures of the infecting organisms.

## ARTERIOVENOUS ANEURISM

DR. HENRY H. M. LYLE presented two patients.

CASE I.—A man, aged twenty-five years, entered St. Luke's Hospital, November 27, 1924, with a diagnosis of osteomyelitis of left tibia and fibula, arteriovenous aneurism of the right popliteal space, multiple foreign bodies.

He was wounded during the battle of the Somme in 1916, receiving a perforating shell wound of the lower third of the left leg and numerous small wounds of both legs. Three days later gas gangrene appeared in the left

leg and spread rapidly. Three general operations with multiple incisions were performed before the gangrene was checked—six months later he was operated on for osteomyelitis of the left tibia—the wound remaining open five months. Two years later the wound broke down and has been opening and closing ever since. Within the last few months the patient has noticed that his right leg and foot have been swelling and that there is some weakness of the right knee, no pain.

Examination shows a chronic ulceration of the inner aspect of the left tibia about one and one-half inches above the ankle-joint. There are numerous vertical scars throughout the leg. The ankle is stiff and the foot swollen. The right leg and foot is larger than the left, there are a number of dilated veins. In the right popliteal space there is a pulsating swelling about the size of a small mandarin. X-ray examination of the left leg shows the presence of an old fracture with osteomyelitis and numerous small shell fragments. Examination of the right knee discloses several small shell fragments and the suggestion of a tumor formation.

*Operation, November 11, 1924*—Obliterative endo-aneurismorrhaphy for arteriovenous aneurism of right popliteal space.

*Pathological Findings*—There was a fistulous communication between the right popliteal artery and vein, resulting in a fusiform dilatation of the artery and dilatation and tortuosity of the vein. The lumen of the artery was coated with laminated clots. The opening in the vein ran downward and outward and then curved back on itself for a short ways. The arteriovenous aneurism was of the direct or aneurismal varix type.

*Operative Procedure*—A linear incision was made in the popliteal space going down through the skin and subcutaneous tissues, exposing the popliteal vessels, which were carefully dissected free from the surrounding tissues. An Esmarch bandage had previously been applied so as to render the field bloodless. The vein was opened for about 3 cm, its lumen explored for the fistulous orifice, such openings as were presented appeared to be collaterals of the vein. It was then decided to open the artery which was done by means of an incision 2 cm in length. The blood clot was removed, and the fistulous opening discovered at the lower portion of the artery just below the incision. It was then probed and the fistula found to take the direction as described above. The opening on the venous side was obliterated by interrupted sutures of silk and chromic catgut. The lumen of the vein was then obliterated by plication sutures of silk and double o chromic. The opening on the anterior side was closed by a purse-string suture of silk and the lumen of the artery was then obliterated by plication sutures. The Esmarch bandage and the tourniquet were removed, all bleeding vessels carefully ligated. The distal portion of the vein was much dilated and distended with blood, but bleeding was readily controlled. The deep fascia was approximated with sutures of chromic catgut. The subcutaneous suture was placed and the skin closed with interrupted sutures of silk. The tourniquet was on for an hour and a half.

Examination of the specimen showed the sac wall to contain several small shell fragments.

**CASE II**—A soldier in the 77th Division received a shell wound of the right leg, June 3, 1918. He entered Evacuation Hospital No. 2, where a diagnosis of compound fracture of both bones was made. The wound was debrided and the shell fragments and clothing removed and the leg treated by the suspension and traction. During the night he suffered a severe secondary hemorrhage which required operative interference to check. The wound

drained for a period of six weeks. The patient wore a Thomas splint for one and one-half years. In 1922, he noticed a swelling on the inner side of the right foot, this broke down and discharged pus for three months. In October, 1924, there was a recurrence of the above symptoms. December, 1924, he was examined at the Veterans' Bureau and found to have an arteriovenous aneurism of the lower third of the inner aspect of the right leg. The dorsal veins of the foot were swollen and showed a visible pulsation. He entered St. Luke's Hospital, December 6, 1924, almost four and one-half years after the original injury.

*X-ray Examination December 8, 1924*—There is an oval swelling on the right tibia at the junction of the middle with the lower third which has the characteristic appearance of an old osteomyelitis. The inner border is very ragged, possibly as a result of operative interference, and surrounding this area are numerous, dense foreign bodies. There is a similar foreign body on the inner side of the bones of the foot.

The aneurism cannot be made out in the roentgenograms.

*Operation December 9, 1924*—Arteriovenous aneurism of the posterior tibial of the right leg. Obliterative endo-aneurismorrhaphy.

*Pathological Findings*—There was an arteriovenous aneurism in the antero-internal aspect of the right leg, about the level of the aneurismal varix of the direct type. The sac was about 2 cm in diameter, occupying a position close to the bone and had rounded out a smooth concavity in the bone for itself. That portion of the sac attached to the bone was quite adherent. About five or six venules communicated with the sac. There were areas of calcification involving the intima of the sac and around the periphery of the sac were numerous small black foreign bodies, some consisting of shell fragments and one or two of shreds of clothing. The veins, distal to the sac, were tortuous and dilated. When the sac was obliterated there was no pulsation in the veins of the internal side of the foot, nor was there a bruit present. However, there was a distinct pulsation in the region of the posterior tibial artery as it passed around the internal malleolus. There were several large adherent scars over the anterior and internal side of the leg, the result of previous osteomyelitis. Examination of the specimen showed the sac wall to contain numerous small shell fragments.

*Operative Procedure*—An incision was made over the pulsating area at the junction of the middle and lower thirds of the leg, exposing the dilated veins. The dissection then carried down to the bone and the aneurismal sac located. In attempting to dissect the sac off the bone, the wall was punctured so that the sac was then laid bare for some distance. The sac was further dissected away from the surrounding tissues above and below and the communicating venules tied off. At this junction the tourniquet was released and a moderate degree of venous hemorrhage occurred which was controlled by means of ligatures. Several dilated varicose veins were removed and the subcutaneous tissues and deep fascia were then closed over the posterior tibial nerve which had been exposed during the dissection. The skin then closed with a right angle suture of silk, after a large scar was dissected off the bone. An incision then made over the internal side of the foot exposing one of the large dilated veins, which was divided between ligatures and the incision closed.

The interesting points in these cases are the delay in the development of the aneurisms and the presence of small shell fragments in the sac walls. The irritation of the small sharp shell fragments has been a factor in the



causation of these lesions and this must be kept in mind in dealing with such cases. The records show that aneurisms with these findings are occurring much more frequently than had been supposed.

## SEPTIC ARTHRITIS OF KNEE

DR CHARLES E. FARR presented a child who at four and one-half years of age, entered the New York Hospital, service of Doctor Gibson, March 11, 1925, and was discharged cured March 31, 1925. Ten days before admission the child was alleged to have hit her right knee with a pin. That night the knee became red, swollen and tender. The family physician told them to use cold applications. Three days later a blood culture was taken showing staphylococcus aureus. An X-ray was also taken, but it showed no bone involvement. On admission the child's right knee and thigh were greatly enlarged, brawny, red and extremely tender. Motions were almost completely lost. The temperature was 103, pulse 130. The leucocytes were 27,000 with 87 per cent polymorphonuclears. The red cells were 2,880,000 with 50 per cent hæmoglobin. The blood culture was negative. The child was operated upon at once, using long lateral incisions, and opening the knee-joint widely. A large amount of thick pus was evacuated from the knee-joint and from a huge pocket beneath the vastus externus extending half-way up the femur. No drain was used. A small moist dressing was applied. The wound culture showed streptococcus hæmolyticus.

Every endeavor was made to induce the child to use the knee, but this is always extremely difficult in little children. The procedure adopted was to tickle the child's sole at frequent intervals. This caused voluntary flexion. The foot was then grasped and traction gently applied until the leg was nearly straight. In this way the desired motion of the joint was obtained without trauma. On the seventh day, at the suggestion of Doctor Gibson, the child was allowed up and encouraged to walk. Drainage from the knee-joint had practically ceased. On the fourteenth day 50 per cent motion was present and the wounds were healed to superficial granulating sinuses. The temperature and pulse dropped rapidly after operation and the child has made an uninterrupted recovery. At the present time, April 22, six weeks after operation, the wounds are nearly healed and motion is 75 per cent of normal. X-rays taken a week after operation showed no involvement of the bone.

*Comment*—This was a savage infection of the knee-joint and of the intra-muscular planes of the thigh. The child was desperately ill. The treatment and outcome illustrate well the great advantage of the Willems treatment.

## STRANGULATED FEMORAL HERNIA, AND SLIDING HERNIA OF THE BLADDER IN A CHILD

DR CHARLES E. FARR presented a boy, who, at ten years of age, entered New York Hospital, April 5, 1925, in the service of Doctor Gibson. His chief complaint was of a mass in the right groin, with vomiting and diarrhoea. The mass had been present only a few hours. Physical examination showed an ovoid mass 2 by 1 inch in the right groin and slightly below the inguinal ligament, evidently a strangulated femoral hernia. The boy's general condition was excellent. There was no bladder symptoms. His past history indicated a poliomyelitis in infancy affecting the abdominal muscles, and the muscles of the right thigh and leg. He has had an operation on the right ankle in another hospital.

## SPLENIC ANÆMIA, COMPLICATED BY LUNG ABSCESS

January, 1925, he entered New York Hospital and was operated upon for a weakness in the right groin which proved to be a bulge in the direct triangle without an actual hernial sac. At this time the physical examination showed a soft irreducible swelling below the inguinal ligament and about one-half inch in diameter.

At operation on the second admission the usual vertical incision was made. A typical femoral hernia sac was developed and opened. It contained a strangulated loop of ileum which was observed for a few moments, found to regain its color and reduced with some difficulty, after nicking Cooper's ligament. The sac was then dissected high up in the femoral canal. The fat in the thigh surrounding the femoral opening had a peculiar appearance and bled more than usual. It was dissected up and found to contain a large portion of the urinary bladder, extending out of the canal into the thigh internally, posteriorly, and slightly externally to the sac of the true hernia. The bladder was freed in all directions widely, the bleeding carefully controlled, and the mass was then reduced with ease inside the abdominal cavity. The hernial sac was then doubly ligated and cut away. The inguinal ligament was sutured to the pectineal muscle and fascia with interrupted chromic catgut. The wound was closed in the usual manner and healed by primary union. Convalescence was uneventful.

*Comment*—Beyond reasonable doubt the sliding hernia of the bladder was present at the time of the original operation, and was overlooked, as was the small femoral sac. Sliding hernias of the bladder into the femoral space are uncommon, but probably not extremely rare. The unusual feature in this case was the lack of bladder symptoms or abnormal urinary findings at any time, either before or after operation.

## SPLENIC ANÆMIA, COMPLICATED BY LUNG ABSCESS

DR CHARLES E FARR presented a little girl, who at five years of age, entered St Mary's Free Hospital for Children, September 27, 1923. For the previous two years she had had frequent attacks of fever, headache and malaise, lasting three days to a week. The present illness came on suddenly September 23, 1923, with headache, fever, malaise, pain in the abdomen, diarrhoea and frequent urination. She had been coughing a day. She had been in the hospital, January, 1923, for an infected vaccination, and again in February, 1923, when a diagnosis of acute catarrhal jaundice was made, but she was sent home the next day with a positive diphtheritic throat.

Physical examination showed a child with a typical lobar pneumonia involving the left lower lobe. There was no râles at this time. The abdomen was prominent and soft. The liver was five fingers below the costal margin. The spleen was palpable below the costal margin. The extremities were normal. The skin and the sclerae were icteric. Her temperature was 103-8/10. Signs of fluid in the left chest were obtained October 4, 1923, and the chest was aspirated three times and then a thoracotomy performed October 12, 1923. From time to time thereafter the wounds were enlarged and the thorax explored because of lack of good clinical progress.

She came under Doctor Farr's care, February 1, 1924. Examination at this time showed an anæmic, jaundiced, frail child whose left chest was discharging freely. A lung abscess was detected by X-ray. The liver and spleen were moderately large. There was some fluid in the abdomen. On February 2, 1924, the blood count showed hæmoglobin 55 per cent, red cells 2,180,000. Repeated transfusions were done with temporary benefit. Finally the thorax was thoroughly opened and the lung compressed against the

mediastinum with vaseline gauze packs and rubber drain. Healing of the lung abscess occurred fairly promptly and a large clean granulating wound obtained. The bleeding time was five minutes and the coagulating time was ten minutes. Differential count showed Turck's cells and a few myelocytes, with anisocytosis, poikilocytosis and achromia. In April, the hæmoglobin had risen to 60 per cent, the red cells were 3,904,000. There was considerable bloody oozing from the nares and from the wound.

On May 2, 1924, a splenectomy was performed with the usual technic. The spleen was about three times normal size. The surface was irregular. The liver was moderately enlarged, very nodular and rough. A moderate amount of bloody fluid was in the abdomen. On May 12, the entire wound separated although there was no infection. It was re-sutured with success. The hæmoglobin and red cells fell moderately, but there was at this time no abnormal cells and slight poikilocytosis. In June the hæmoglobin reached 58 per cent, and red cells 3,584,000. There was a considerable effusion in the abdomen during the summer, but the child improved with country treatment. She received one more transfusion. The effusion was absorbed and her general health was fairly good. The jaundice had cleared up, but the liver was palpable. Both wounds were firmly healed.

Microscopic examination of the spleen was not typical of Banti's disease, although the clinical picture was quite characteristic. Wassermann tests of the child and parents had been negative throughout. The pathologist, Dr. William Clark, reports as follows: "Splenic corpuscles were reduced in number, the sinuses were dilated, the connective tissue œdematous. There was no increase in fibrous connective tissue. A second section showed connective tissue infiltrated with polymorphonuclear leucocytes." The pathologists suggested some kind of purpura. The urine showed bile at intervals and occasional red blood-cells, constant albumen and occasional casts.

In December, 1924, the child returned to the hospital with pronounced jaundice, fever, vomiting, epistaxis. Her blood count at this time showed hæmoglobin 45 per cent. A transfusion was performed and she received Alpine Lamp treatment every second day. Improvement was rapid and has been continuous since. The child is now in fairly good general health but cannot be considered cured.

*Comment*—Clinically this was a typical case of Banti's disease with the incidental bleeding common to this disease. Doctor Clark, after mature consideration of the history and the pathological specimen is still firmly under the conviction that the condition was purpura. It would seem under the circumstances that the clinical diagnosis is probably correct.

DR. EDWARD W. PETERSON said he had a patient with severe anæmia who had a very large spleen and liver. Splenectomy was followed by marked improvement for a time, but the hemorrhages again recurred, the anæmia became more pronounced and the child succumbed in spite of blood transfusions.

DR. EUGENE H. POOL said it is difficult to classify these cases. Many consider that splenic anæmia is really an early stage of Banti's disease, that if the disease progresses, cirrhosis and ascites will develop, the terminal stage being called Banti's disease. Numerous cases of splenic anæmia have been followed for many years after splenectomy with apparent cure, the speaker had a case which he had followed for about ten years and the patient continued in good condition.

## FRACTURE OF THE HARD PALATE

DOCTOR FARR, in closing the discussion, said that these cases are much improved by splenectomy even in fairly late stages. If they can be operated on early, one can count on a cure.

### FRACTURE OF THE HARD PALATE

DR CHARLES E. FARR presented two patients.

CASE I—A boy, nine years of age, entered St. Mary's Free Hospital for Children, March 7, 1925, and was discharged March 29, 1925. One hour previously he had been knocked down by a taxicab. He was not unconscious, was bleeding from the mouth and nose and was somewhat stuporous. Examination showed a fracture of the right mandible near the front, a laceration of the chin, many contusions, a possible fracture of



FIG. 3—The fractured mandible in Case I.

of the left orbital plate, loss of five upper front teeth. The hard palate was split for a distance of about two inches in midline beginning with the alveolus and extending backward to the junction with the soft palate. The eyelids were much discolored and swollen. There was a swelling of the right mandibular joint. He was in considerable shock. His nose was full of

blood. His pupils were equal, dilated, and reacted sluggishly to light. His right middle ear contained blood behind the drum. His reflexes were normal except for an exaggeration of the knee jerks. His pulse was 70 and his temperature was 99. He made an uninterrupted recovery, although his temperature rose to 102-2/10, and the pulse to 120, and he was drowsy and irritable at intervals. The discoloration of the eyelids increased and then diminished. Examination of the eye-grounds by Doctor Cutler on the fourteenth day under homatropin showed both optic nerves slightly paler than normal with normal retina and vessels. There was also slight increased resistance of the right orbit on pressure downwards and backwards. March 15 it was



FIG. 4—The fractured hard palate in Case I.

noted that the cleft in the palate was covered with granulations. March 22, slight asymmetry of the face noted. The right palpebral fissure was widened, and the palate was healed.

In these automobile cases it is usually impossible to tell how the violence produced the fracture. It would seem probable that he received a sharp blow on the chin chiefly upwards, forcibly separating the hard palate by impact against the upper teeth.

The technical difficulty of showing these fractures of the palate, and those of the anterior portion of the mandible was overcome by use of a large dental film within the mouth.

CASE II—A boy eight years of age, entered St. Mary's Free Hospital for Children, March 16, 1925, and was discharged April 25, 1925. One hour previously he had been knocked down by a taxicab. He was conscious,

and bleeding from the nose, which was fractured. There was marked swelling and discoloration of both lids. The pupils were equal and reacted to light. There was no strabismus and his ears were normal. There was a doubtful fracture of the mandible near the front. The hard palate was open for a distance of one inch just back of the alveolus. There was free bleeding from this and from the nose and a profuse watery discharge presumably from a fracture of the cribriform plate. There was a fracture of the cuboid, and the first and second metatarsals. There was a left knee



FIG. 5.—Fracture of the hard palate in Case II.

and ankle clonus but no Babinski. He was in moderate shock. His temperature rose to 102.6/10, and pulse to 124 but soon subsided to normal. There was an infection of the left maxillary sinus which was drained through an opening beneath the upper lip. There was also a free purulent discharge from the nose. The spinal fluid remained clear but contained five leucocytes and many red blood-cells. The Noguchi test was positive. A culture and smear of the antrum pus showed mixed streptococcus and staphylococcus. On March 19 there was a suggestive left Babinski. X-ray showed an apparent fracture of the posterior portion of the right temporal bone. March 21, there was slight internal strabismus not present before injury. Eye-grounds were negative. The boy made an uninterrupted recovery and is now perfectly well.

*Comment*—This is the second case of fracture or separation of the superior maxillæ within a fortnight. As in the preceding case the application of the force which caused the fracture is in doubt, but presumably it was from below upwards by means of the mandible.

#### UNILATERAL FUSED KIDNEY

DR. CHARLES E. FARR presented a colored boy, two years of age, on whom he operated in St. Mary's Free Hospital for Children March 20, 1925 for umbilical hernia of large size. There was no history of anything abnormal except the hernia. During the course of the operation the abdomen was explored, the left kidney found missing from its usual bed and two kidneys palpated on the right side, one of about normal size, and slightly lower than normal position, the other just on the pelvic brim about normal in size but

## BENIGN TUMOR OF THE STOMACH

irregular in shape. The two were joined by a thick band apparently of renal tissue about one inch in width (Fig 6)

The child made an uninterrupted recovery from the operation and has given no signs or symptoms of his renal abnormality. There is an occasional leucocyte and some epithelium in his urine with amorphous urates. The diagnosis of fused kidney is rarely made except by pyelography. Even more rarely the condition is found incidently on operation as in this case. The importance of its recognition is obvious. Unless infection, calculus, or tuberculosis develop, or an unwarranted surgical attack is made, these fused kidneys are compatible with long life and good health.

DR EUGENE H POOL said that some years ago he had a case which he operated for calculi in the left kidney and discovered a horseshoe kidney, the two kidneys being fused. There were numerous large calculi present in what corresponded to the left kidney and that portion of the kidney was resected. The patient still has a urinary fistula.

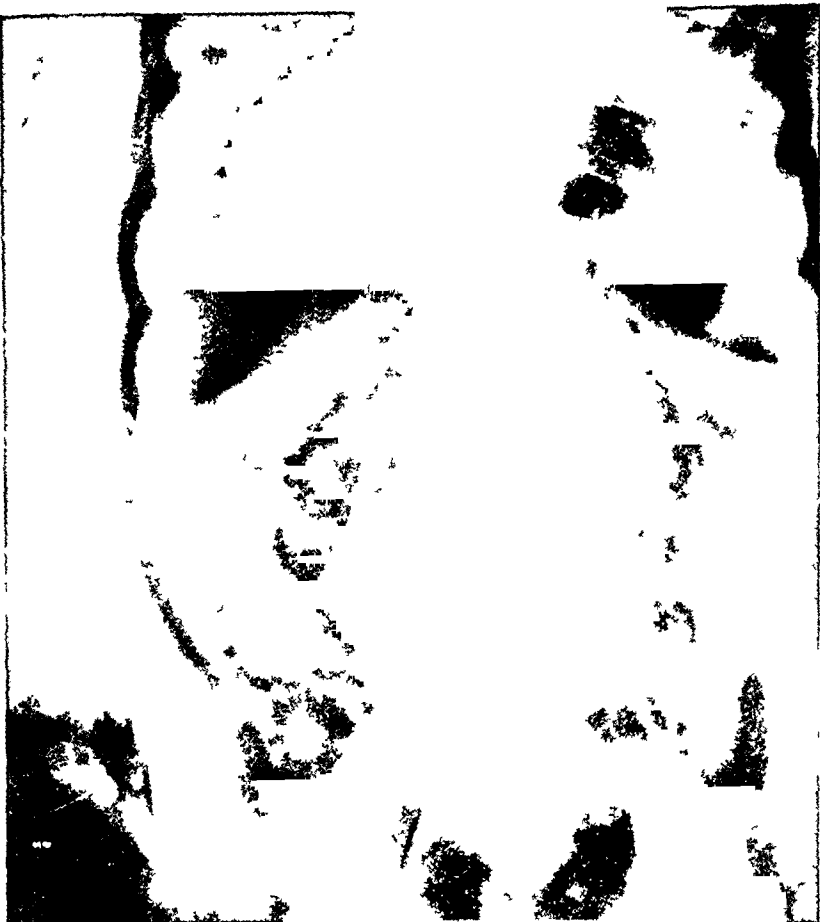


FIG 6—Unilateral fused kidney (right) pneumoperitoneum

## BENIGN TUMOR OF THE STOMACH

DR CHARLES E FARR presented a man, who at sixty years of age, entered the New York Hospital, private pavilion, July 11, 1924, and left July 27, 1924. His chief complaint was weakness and distress in the chest and abdomen. His history dates back about one year when he had an attack of influenza. His pain was irregular and was relieved by soda, or simply by pressure. His weakness had been progressive, and he also suffered from high blood-pressure and Bright's, with dyspnoea on exertion, and anginal attacks. Previous to admission he had been under the care of Doctor Keays and Dr Herman Mosenthal, who had diagnosed a benign tumor of the stomach basing this on the duration without cachexia. There was occult blood in the stools and the X-ray showed a movable shadow in the central portion of the stomach, apparently a polyp (Fig 7). There was no marked loss of weight.

On admission to the hospital the hæmoglobin was 40 per cent, red cells 2,500,000, the leucocytes 6500 with 60 per cent polymorphonuclears. He was operated upon July 14 under colonic oil ether anæsthesia. A pedunculated mass nearly 6 cm in diameter was found on the posterior wall about the middle of the stomach. Gastrotomy allowed an easy delivery of the mass.

The pedicle was clamped and the tumor removed. The base was cauterized and whipped over with chromic catgut, the gastric and abdominal wounds were then closed in the customary manner. He made an uninterrupted recovery. His highest temperature was 100-8/10 and pulse 90. July 23, his hæmoglobin had risen to 52 per cent. Improvement was continuous but slow during the summer. In September, 1924, he suffered an attack of acute volvulus from which he recovered spontaneously just as he was about to be operated upon. His hæmoglobin is now 80 per cent, his general strength better, but he still

suffers from the original cardiac and arteriosclerotic symptoms with angina. He is able to get about and attend to his business, has gained much weight, has no gastric symptoms and no occult blood.

The pathological report is as follows:

"Papilloma of stomach. Specimen (Fig 8) consists of an oval pedunculated villous tumor 6 x 4 x 4 cm, soft, covered with villi which are about 1 cm in height and vary from 2 to 5 mm in diameter. The base which is not indurated is 25 mm in diameter.

"Microscopic examination (Fig 9) of material from several portions of the growth and of the base shows no definite



FIG 7 — Benign tumor of the stomach

evidence of malignancy. There is no invasion of the subjacent structures, although in places there is evidence of very active proliferation leading to a piling up of cells which, however, are still fairly well oriented. The tumor can be ranked as a papilloma of the stomach, although it must be borne in mind that these tumors are prone to undergo malignant transformation. As a rule this occurs very late after it has assumed large proportions. Since only a relatively small portion of the growth can be examined microscopically, it is not possible to absolutely exclude such an occurrence in any instance and this should be considered in rendering a prognosis."

*Comments* — The unusual feature in this case is the almost complete absence of stomach symptoms which were simulated in a way by the anginal attacks. The tentative diagnosis of benign tumor of the stomach was founded on reasonably good evidence. The post-operative recovery has been very satisfactory. A similar but larger pedunculated growth in a much younger

man, also practically symptomless except for silent bleeding, was found to be malignant, requiring the resection of about four-fifths of the stomach. It is questionable whether such radical resection is justified in a pedunculated growth without metastases, particularly where the situation of the growth necessitates a difficult technical procedure.

## CARCINOMA OF THE CLITORIS

DR JOHN C A GERSTER presented a case of carcinoma of the clitoris with bilateral excision of inguinal lymph-nodes one year after operation. The patient was a woman of fifty-six,

who was admitted to the Fifth Avenue Hospital, March 13, 1924. Her mother died of cancer, her father of dropsy. Had been married for some

thirty years. Had several miscarriages but never any full-term pregnancies. She suffered from rheumatism in her legs for some years past, otherwise well.

One year ago she noticed a painless lump in both groins, the right larger than the left. Also a mass in the vagina, which was tender and bled easily.

On physical examination the patient proved to be an obese woman in fair condition, whose general physical condition revealed nothing abnormal considering her weight and age.

Locally there was a tumor the size of a cherry involving the distal half of the clitoris, tender and ulcerated. There were hard painless masses in both inguinal regions 3 x 4 cc in extent on the left and 2 x 6 cc on the right.

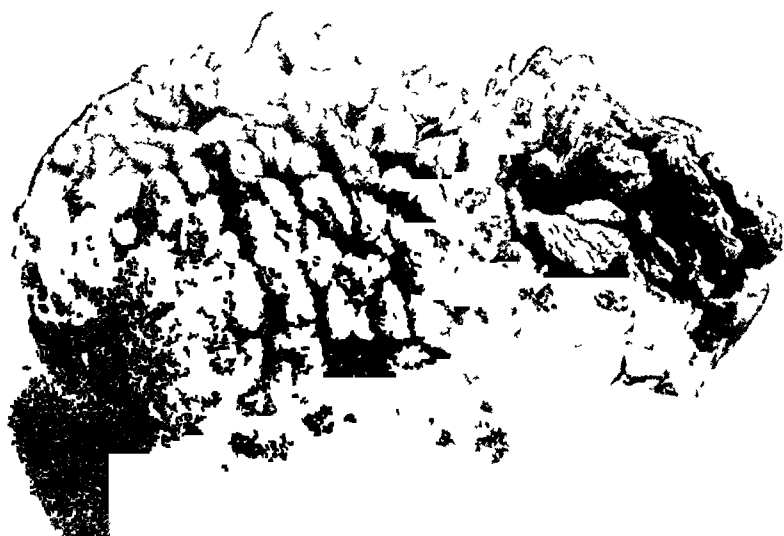


FIG 8 —Papilloma of stomach, after removal

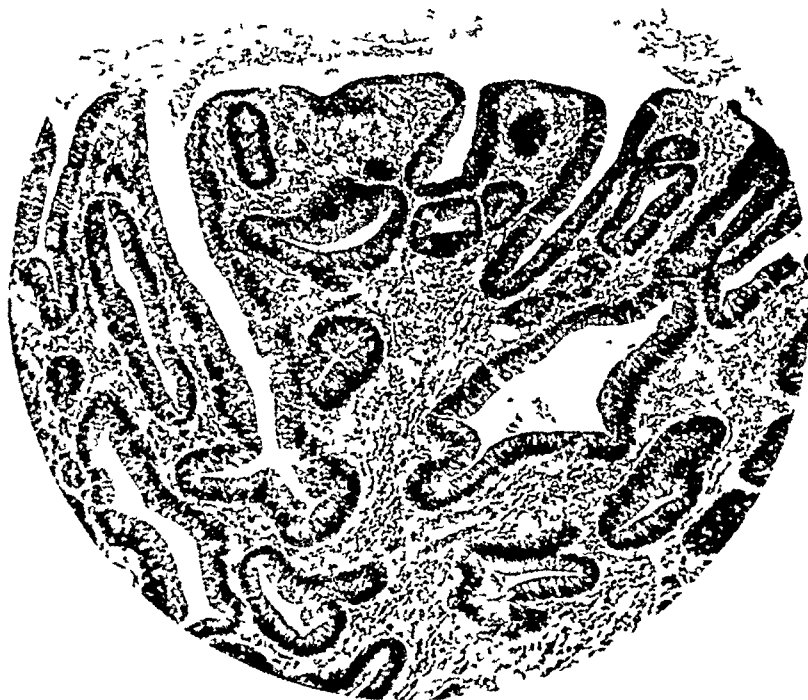


FIG 9 —Papilloma of stomach



March 13, under  $\frac{1}{2}$  per cent novocain anæsthesia, a wide excision of the clitoris and its adjacent tissues down to the symphysis pubis was made with an electric cautery knife. The following day, under local anæsthesia, a block dissection of the right inguinal region with extirpation of nodes and parts *en masse* down to deep fascia was made. This included stripping of subcutaneous fat from inguinal region to vulva. March 15 a similar excision under local anæsthesia was performed on the left side. Naturally the wounds were mildly infected but she made an uneventful recovery and was discharged April 6, 1924. On the twenty-fourth day after the first operation. Since then she has received radio therapeutic treatment at St. Luke's Hospital.

A few weeks ago a tender swelling was noted in the left major labium. An abscess formed, opened spontaneously, and the mass disappeared. Several similar tender masses are now present in the right side of the mons veneris apparently inflammatory in character. There is some erythema of the skin in both inguinal regions but so far no signs of recurrence. She has not lost weight. Microscopical examination by Dr. S. D. Jessup, pathologist of the Fifth Avenue Hospital, showed a prickle-cell epithelioma of the clitoris with secondary deposits in both masses of inguinal nodes at their centres. The outlying nodes showed congestion and hyperplasia.

#### CLINICAL CONSIDERATIONS OF THROMBOSIS AND EMBOLISM

DR. JOHN A. VICTOR read a paper with the above title, for which see August ANNALS OF SURGERY vol LXXII, p. 193.

DR. WILLY MEYER said that it was now generally accepted that Aschoff's theory is likely correct, that due to microorganisms floating in the blood, inflammatory deposits and thrombus formation, occurred in such vessels of the venous system where the blood stream is slowing up. It is usually the left femoral vein that is involved, and the theory of the slowing of the blood stream just underneath Poupert's ligament is well supported by anatomical facts. If we place the patient in a position, in which this portion of the blood stream is accelerated, we are observing a prophylactic point. Since Doctor Meyer had placed the patients operated upon in a slight Trendelenburg's posture he had not seen any thrombosis of the left femoral vein. We are living in a prophylactic age, every physician and surgeon should try to avoid possible trouble. Whoever has had one of these cases of post-operative femoral thrombosis under his care would, he was sure, never forget it on account of the annoyance caused to the patient and himself.

Regarding embolism, there is a difference between embolism of an artery of an extremity and pulmonary embolism. Every busy surgeon had seen cases in which after a chronic endocarditis suddenly the brachial or iliac or femoral artery became plugged. These are most important cases. If the embolus could be localized and the patient able to stand an operation, cutting down onto and into the artery and removing the embolized thrombus and then sewing up artery and wound is the ideal procedure. If the exact place cannot be diagnosed, regular and prolonged baths of superheated air, immediately started, could prevent gangrene.

## CLINICAL CONSIDERATIONS OF THROMBOSIS AND ANEURISM

A word on pulmonary embolism Many patients die immediately from shock, others in three to five minutes It has been stated in the literature that about one-half of the severe type live from ten to sixteen minutes It was based on careful observation and experimentation when Trendelenburg sixteen years ago proposed to extract pulmonary emboli Members of the staff and nurses must be trained and everything be ready for the operation, the assistants must know how to proceed because there are just the ten to fifteen minutes time in which the patient may be saved Twelve years ago Doctor Meyer had tried the operation on dogs He could show one dog who had recovered before the Surgical Society The work must be done with the help of differential pressure and oxygen It was the crowning point of Trendelenburg's life that when he attended the meeting of the German Surgical Congress in 1924, Kirschner, of the University of Königsberg, was showing a patient who had recovered from this operation which had been carried out in every detail according to the rules laid down by Trendelenburg With one patient recovered and a record of a few who have lived three, four and five days after the operation, pneumonia having been the usual cause of death, the time seems to have come when one should not wait to see what will become of these patients, although a very small percentage will recover spontaneously Every hospital should be prepared to do Trendelenburg's operation, but it is necessary, as said before, that assistants and nurses are trained to recognize immediately when a pulmonary embolism has happened An attempt should be made to save these patients as most of them are lost if not operated on Trendelenburg advised to compress pulmonary artery and aorta with an elastic tube Then only 45 seconds are at the disposal of the operator to extract the emboli The right heart is always distended to the utmost capacity Incision of the pulmonary artery brings immediate relief It has been found if the superior and inferior vena cava are compressed, eight to ten minutes are at the disposal of the operator If the assistant compresses these two veins the surgeon can extract the emboli with more leisure and a greater number of these patients may likely recover

DR WALTON MARTIN spoke of a patient who was operated on for appendicitis and recovered and during the second week had a pulmonary embolism He was given quantities of morphine and the pain passed off and his life was saved This same treatment was given to another patient who had been operated on for carcinoma and developed signs of pulmonary embolism and recovery also occurred in this case He died one month afterward and at autopsy the plug in the artery could be seen This is a reflex condition which kills and it is worth while bearing in mind

DR JOHN A HARTWELL said that he had been a victim of pulmonary embolism He could confirm Doctor Blake's description The one thing he desired was morphine, which he preferred to an operation on the pulmonary artery

DR WILLIAM B COLEY stated that, in his experience, embolism following operation for hernia had been extremely rare. In 1918, in a report of 8589 cases of hernia treated by radical operation from 1891 to 1918 (by Coley and Hoguet) not a single case of embolism was noted. At the Mayo Clinic from 1899 to 1911, five per cent of the total number of deaths following major abdominal operations were due to post-operative embolism.

DR BURTON J LEE said that bearing on the question of infection it is interesting to note that a head nurse working in a New York Hospital has frequently predicted that a case might develop pulmonary embolism and upon three occasions has been correct in the prediction. The suggestive symptoms had been a slight temperature, associated with some general malaise and indefinite abdominal discomfort. Following these observations, the speaker had kept close watch upon his patients and had found that quite routinely a slight temperature rise had appeared before embolism had occurred.

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting Held May 8, 1925*

The President, DR EDWARD B HODGE, in the Chair

## CYST OF THYROGLOSSAL DUCT

DR JESSIE W PRYOR presented a man, aged twenty-seven years, who was admitted to hospital complaining of a swelling in his neck. This mass was first noticed five years ago, when it was the size of a pigeon's egg, it has been growing slowly until it now in size and shape is equal to a hen's egg. The mass lies just to the right of the midline in the upper part of the neck. (See Fig 1) It extends to the midline, but does not cross it. It is freely movable, circumscribed, soft, no fluctuation obtained and no pulsation or bruit. On swallowing, the mass is definitely elevated and quickly descends as though attached to the base of the tongue.

The mass was a little too high to be a cyst of the right lobe of the thyroid. The man came to operation with three diagnoses suggested by three people: (1) Branchial cyst, (2) Lipoma, (3) Cyst of thyroglossal duct.

The definite attachment to the base of the tongue caused the reporter to stick to the thyroglossal idea even although the mass was definitely on the right side and not in the midline.

A collar incision was made in the crease of the neck through skin and platysma, crossing from the anterior border of one sterno-mastoid muscle to the anterior border of the other. The flaps were retracted up and down. The pretracheal fascia was then incised vertically and dissecting with finger and scissors a mass, the size of an egg, was freed on each side and posteriorly. The appearance of the cyst at this stage was fusiform, the upper pole was very definitely attached to the lower border of hyoid bone and the lower pole attached to upper margin of the right lobe of the thyroid.

About this stage the cyst was ruptured. It contained opaque yellowish semi-gelatinous fluid. The cyst wall was then ligated at the attachment to thyroid gland and as close to the hyoid bone as possible. The bands were cut, the pretracheal fascia closed, the platysma sutured and the skin wound closed. The recovery was uneventful.

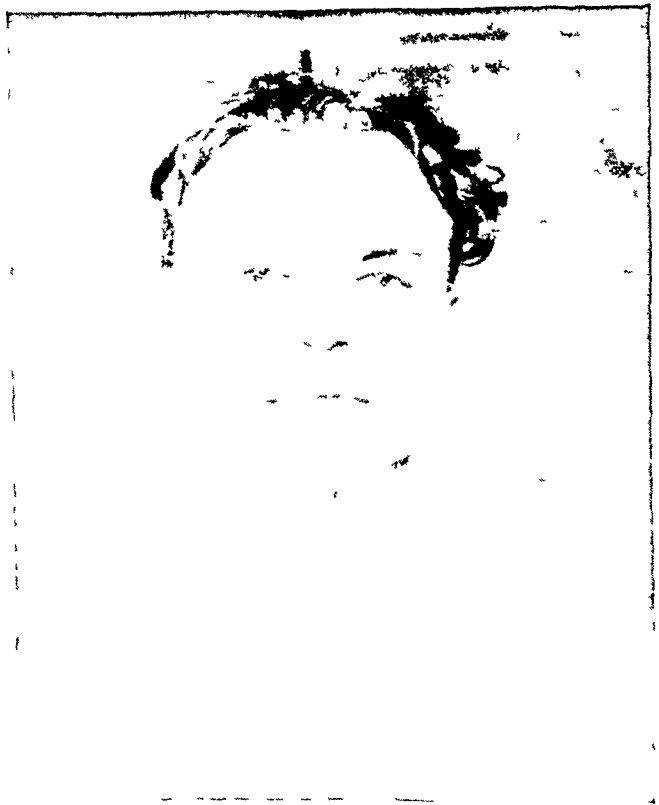


FIG 1 —Thyroglossal cyst, anterior view

*Pathologist's Report*—The specimen consists of the wall of a cyst about the size of an almond, having a ragged lining and smooth outer surface. Externally it is attached to an elongated mass of tissue about an inch long, apparently the wall of the thyroglossal duct.

*Microscopic Description*—*a* The wall consists of a dense sclerotic fibrous tissue containing masses of colloid inclosed in the interstices and in what appear to be dilated luminae.

*b* Fibrous tissue structure surmounted by laminated wall containing a system of capillaries filled with red cells, and having a homogeneous free surface. At one end is a portion of the same structure seen in colloid masses.

Diagnosis: Cyst of thyroglossal duct.

## RHINOPLASTY FOR SYPHILITIC DEFECT OF NOSE

DR ROBERT H IVY exhibited two cases of total rhinoplasty for syphilitic defect of the nose, in which the Indian flap method as modified by V. P. Blair was used. A single flap is employed to form the entire external nose, its distal end being folded to form columella and lining for alae. These cases demonstrate conclusively that by this method sufficient prominence of the lower part of the nose can usually be obtained without the use of cartilage or other supporting tissue in this region. Cartilage is only implanted in these cases where the nasal bones themselves give no prominence to the upper part of the nose, and even here it is not usually necessary. In one of the cases no cartilage whatever was employed. In the other, a small piece of costal cartilage was implanted over the depressed nasal bones high up beneath the forehead flap.

## INTRAPERITONEAL TRANSFUSION FOR MELENA

DR J. RALSTON WELLS reported the history of a male infant, ten months of age weighing seventeen pounds, who was admitted to hospital, October 11, 1924, on account of persistent voiding of blood per anum. Five weeks ago it first passed bloody bowel movements. Two weeks later the same blood losses occurred. The day before admission its stool was "blackish" in color and very hard. The patient was evidently in distress when passing this stool, as shown by drawing knees up and crying immediately after it. An enema seemed to relieve the pain but the baby became so cold that hot water bottles were necessary for local body application. It vomited twice on this day, no gross blood in vomitus.

When admitted the child looked severely ill and weak but was in no acute distress. Is very pale, no flushes. Breathing is 72, with sometimes an expiratory grunt, pulse rapid, 160 and thready. Temperature 103° F–104° F. Is most comfortable lying with right leg drawn up. Resents disturbance. Abdomen slightly distended and moving with respirations. Palpation shows generalized tenderness and resistance especially marked on whole right side. No palpable masses nor localizing point or points of tenderness. Peristalsis active. Rectal examination gave no additional information. The general physical examination is negative except for the left thorax which shows a slightly impaired percussion note and slight impaired resonance over the lower lobe posterior. No alteration in breath sounds. No râles. Head, heart, extremities and nervous system negative, negative urine.

Blood—Hb 30 per cent, red blood cells 2,500,000.

Third Day—Dark stool passed with large clot of blood. No vomiting but along toward evening appeared in a condition simulating collapse and some liquid dark material resembling blood was passed per rectum. Five cc of horse serum was given intermuscularly.

## INTRAPERITONEAL TRANSFUSION FOR MELENA

Sixth Day —Condition improving, no more hemorrhages seen Temperature now around  $100^{\circ}$ , respiration and pulse in proportion No cough

Seventh Day —Slight hemorrhage Temperature, pulse and respiration became practically normal at this time Slight hemorrhages occurred October 23, November 8, December 17, December 27, January 2, January 3, quite copious hemorrhages occurred November 6, December 25 An intraperitoneal transfusion of citrated blood was first given October 19, when 100 c c of the blood was injected At this date the hæmoglobin had fallen to 22 per cent The proportion of Hb rapidly rose after this injection until at the end of ten days it marked 55 per cent After the copious hemorrhage which occurred November 6, it fell again to 20 per cent Repetition of the intraperitoneal transfusions of 100 c c of blood November 20 was followed by the same gradual increase in the hæmoglobin index until by December 12 it reached 60 per cent After the hemorrhage of December 17 a transfusion was at once resorted to, with again a rapid rise of the Hb index to 65 per cent The repeated hemorrhages late in December and during the first week in January, 1925, caused the decision to make an explorative abdominal incision An X-ray examination had been made December 11, with the report that the plates indicated a marked narrowing of the lumen of the transverse colon for a distance of about three inches near the median portion on the right side, just above umbilicus

The von Pirquet reaction was slightly positive

January 7, under ether, a median incision of the abdominal wall was made A good exposure was obtained Nothing abnormal was detected, except some enlarged intraperitoneal glands No free fluid No indurations or ulcerations seen nor polyps palpated One hundred c c of citrated blood was put into the peritoneal cavity, and the incision closed The operative recovery was uncomplicated

The little patient was retained in the hospital for four months longer, slowly improving, but with a gradual fall in the hæmoglobin index When the child was finally sent home, May 17, it weighed eighteen + pounds, and its Hb index was 35 per cent

DR CALVIN SMYTHE presented a chart which Doctor Sweet and he worked up some five or six years ago when they were making some studies on intra-abdominal absorption Using the red blood-cells as an indicator in lymph collected from the thoracic duct and watching how quickly it came through They found that the invariable result was that in 20 to 30 hours they would get lymph which was absolutely colorless, then a faint trace of color and straight on until they got fluid which was similar to venous blood It could be seen that it contained red blood-cells On dogs which were afterwards post-mortemed they invariably found the pleural surface of the diaphragm to contain large amounts of blood, as if there had been hemorrhage Since Superstein and Stanby wrote their paper on intraperitoneal infusion, he had used the method about twenty-five times in the past year and had found it an excellent one, especially in children It is relatively painless and gives excellent results One does not get an immediate effect, but it seems to be more lasting than intravenous injection He had had no trouble with it Another point in its favor is that one does not have to type the blood They were able to use a donor in many cases that for the purposes of intravenous

injection would not have been the correct type In this method they used 500 c c of the blood with no deleterious effects

#### DEPRESSED FRACTURE OF THE SKULL INVOLVING SPEECH CENTRE

DR JOHN S RODMAN reported the history of a man, thirty-one years of age, who three days prior to admission to the hospital was intentionally struck by a thrown rock in his left temporo-parietal region He fell to the ground and was momentarily unconscious Was picked up at once, regained consciousness, but was dazed and had no memory of what had struck him when taken to the accident ward of a local hospital about fifteen minutes later He was given first aid there, but then allowed to leave, and went to the police station and made a report of his injury He remembers leaving hospital in a machine and being driven home Had a good deal of headache and confusion Vomited after reaching home and at intervals during night On following day headache continued and vomited once that morning, was restless and complained of continual headache, pain in left arm, shoulder and jaws Following day about same He was admitted to hospital on the morning of the third day following accident as his physician felt that he was not improving and that he should be under surgical observation

The following additional information was obtained from his brother upon admission There had been no unconsciousness no incontinence of feces or urine, no paralysis noted Very restless, keeps hands to head and complains of light hurting eyes Asks continuously for water but will not eat solid foods, largely because of pain in jaws Confused, perception slow and speaks with difficulty Several attempts before right word is found Does not sleep but does not notice what goes on around him

*Physical examination* made three days after accident Eyes—pupils equal, react to light, sluggishly to accommodation Tongue protrudes with difficulty because of stiffness of jaws No apparent tendency to protrude to one or to the other side On showing teeth right side of face seems to lag a little and this side of face seems to be smoothed out Apparently has more power in left than in right arm No difference in lower extremities Tendon reflexes diminished No clonus Tests for sensation unsatisfactory owing to patient's mental condition, as he is conscious but irritable and mentally dull Blood-pressure 118-78, P R 60, temperature 98 The diagnosis arrived at was extra-dural hemorrhage with fracture of vault X-ray showed a fracture apparently not depressed, in the left temporo-parietal region

Operation revealed a circular fragment of skull driven inward over left temporo-parietal region No extra-dural clot Dura not opened The depressed fragment was elevated

The man, after remaining about same for four days as before operation began to improve, his mentality cleared, speech returned to normal He was discharged well, ten days after operation

#### To Contributors and Subscribers

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N Y

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

#### ANNALS of SURGERY

227-231 So 6th Street

Philadelphia, Penna

# ANNALS *of* SURGERY

VOL LXXXII

DECEMBER, 1925

No 6

## CANCER OF THE THYROID AND ITS PRESENT-DAY TREATMENT

EMBODYING THE EXPERIENCE OF THE MEMORIAL HOSPITAL OF NEW YORK

BY LLOYD F CRAVER, M D

OF NEW YORK, N Y

ASSOCIATE ATTENDING PHYSICIAN, MEMORIAL HOSPITAL

RECENT reports in the literature of cancer of the thyroid, chiefly from German and American sources, are considerably at variance in regard to the method of choice and the results of treatment of this condition. Some in Germany have noted recently a movement in favor of radiation of malignant goitre, similar to that which has already taken place in the case of cancer of the cervix of the uterus,<sup>30</sup> while others relegate radiation to a very insignificant rôle as a sort of placebo treatment of advanced hopeless cases.

In view of some interesting points discovered in a study of 33 cases treated at the Memorial Hospital, it appeared worth while to review the literature in order to collate some of the more remarkable features of this disease and to bring together the conflicting statements of various writers in the hope that thereby the present situation may be somewhat clarified. This partial review of the literature, together with a report of the cases treated at the Memorial Hospital, constitutes the subject-matter of this article.

Because of the marked variations in the structure of thyroid tissue, both normal and neoplastic, depending upon functional activity and various other factors, special standards<sup>18</sup> are required in the interpretation of its tumors, which do not apply elsewhere. The malignant qualities of a thyroid tumor must be judged less from the microscopical appearances and more from the clinical aspect. Allen Graham says<sup>20</sup> "So far as diagnosis is concerned, it makes very little practical difference what the tumor looks like under the microscope. The malignancy depends upon the tendency or capacity of the tumor to invade locally, cause local destruction, give distant metastases, and finally to result in the death of the patient. Local invasion is the most important index of malignancy."

Much is written about sarcoma of the thyroid, but Ewing<sup>18</sup> finds that the mesoblastic origin of most of the sarcomas reported in the literature is highly improbable, and that the occurrence of true sarcoma of the thyroid in man still requires demonstration.

*Etiology* *Long Duration of Preexisting Goitre*—Practically all writers, with the exception of Bloodgood, emphasize the frequency with which a



malignant tumor of the thyroid is preceded by a long-existing enlargement of the gland. Bloodgood,<sup>6</sup> writing in 1906, found in 9 cases of cancer of the thyroid a history of goitre earlier in life in only one case. On the other hand, Balfour - of the Mayo Clinic, in 1918, stated that in his experience he had not met with a single case which gave unmistakable evidence of having developed within a normal thyroid. He believes that "an incontrovertible argument for operation in cases of adenomatous goitre is the fact that cancer is practically not known to have developed in a healthy thyroid gland. Pre-existing disease has always been in evidence, so that adenomatous goitre may be looked upon, to a certain extent, as a precancerous condition."

L. B. Wilson,<sup>78, 79</sup> at the Mayo Clinic, found in 1921 that of 290 malignant goitres, 159 had an enlargement of the thyroid for five years or longer, and 229 for more than one year. He states<sup>80</sup> that many cases apparently start as adenomas in the third decade and progress very slowly. "Thus, while a sudden increase in rate of growth of a long-standing nodular tumor of the thyroid in a patient more than thirty-five years of age is strongly indicative of beginning malignancy, a slow continuous growth of a nodular tumor may be almost equally indicative of the same condition."

Muller and Speese<sup>81</sup> found that 53 per cent of their cases gave a history of a previous goitre, and that in over one-half of these cases the goitre had existed for more than ten years. Combining their figures with those of Ehrhardt they found the duration of previous goitres as follows:

1 to 10 years, 33 cases	30 to 40 years, 9 cases
10 to 20 years, 21 cases	40 to 50 years, 3 cases
20 to 30 years, 16 cases	

Speese and Brown,<sup>81</sup> in a study of 28 cases, found a history of pre-existing goitre in 22, or 78.5 per cent, with the following distribution:

3 years, 1 case	15 years, 6 cases
6 years, 2 cases	18 years, 1 case
10 years, 3 cases	20 years, 1 case
13 years, 1 case	

Simpson<sup>82</sup> states that 90 per cent of the carcinomas spring from pre-existing goitre. Trotter<sup>83</sup> thinks that carcinoma never appears except in a gland previously abnormal, while John Rogers<sup>84</sup> has stated that clinically he has observed two varieties: one type developing extensively throughout the greater part of a long-standing simple goitre, with early involvement of lymphatics, the other type originating and remaining in some localized portion of an otherwise healthy gland, being hard and nodular, and involving lymphatics very late.

J. Tate Mason<sup>85</sup> reports a carcinoma in a man of fifty-nine who had first noticed a small lump in the thyroid soon after he had been strangled in a fight when only sixteen years old. This lump remained stationary in size for twenty years, then for two years it enlarged until it reached the size of a lemon, again remaining stationary in size for twenty years, having begun again to enlarge one year previous to Mason's observation.

Kraus<sup>86</sup> relates the history of a man of sixty-seven who first noticed a goitre twenty-nine years before, and who during a period from 1899 to 1913 had three operative removals, followed each time by a recurrence. He states that most cases have had a goitre for ten years or longer.

Klose and Hellwig<sup>87</sup> comment on the long duration of pre-existing goitre in many cases, mentioning one case that had a goitre for twenty-six years, and express the opinion that malignant struma is most frequent in the fifth decade, not only because cancer is a disease of middle and old age, but also because in these years the nodules of nodular

## CANCER OF THE THYROID TREATMENT

goitres are in their stage of maturity and degeneration. They find that in their locality (Schmieden's Clinic at Frankfurt), cancer begins almost exclusively in the right lower pole, and state that similar observations, though not so pronounced, were made by Bossart. Their explanation is that in general the growth of the nodules of a nodular goitre begins in the right lower pole, and that therefore it is there that the largest and most degenerated nodules are found. Delore, Lucke, Carrel-Billard, and Lartigau are cited by Speese and Brown<sup>51</sup> as laying much stress on the etiologic significance of benign growths. Bland-Sutton<sup>4</sup> states that cancer of the thyroid is more liable to attack a diseased thyroid, and in common with many other writers mentions the oft-repeated statement that cancer of the thyroid is more common in endemic goitre regions.

Allen Graham<sup>39</sup> states that 95 per cent of the malignant growths of the thyroid are carcinoma, and of these fully 90 per cent arise from fetal adenoma, passing through the stage of "malignant adenoma." He finds a small number of carcinomas not dependent upon adenomata for their origin, most frequently papillary carcinoma, which, according to him, seems to originate in papillomatous processes found in non-adenomatous as well as in adenomatous (not necessarily fetal) thyroids.

Finally, Ewing<sup>18</sup> states that fetal adenoma may give origin to adenocarcinoma, carcinoma and many so-called sarcomas, it arises early in life and appears as a definite tumor usually before the twentieth year. Under the caption adenocarcinoma or malignant adenoma he states that the appearance of the tumor is usually preceded by a period of slow enlargement of the gland which may extend over several years. Again, under papillary epithelial tumors, some of which are malignant, they "are usually preceded by chronic enlargement of the thyroid and growth is relatively slow." Under carcinoma, he states "most cases arise in goitrous glands."

The slow growth in some cases of thyroid cancer suggested to Chambers<sup>11</sup> that in many instances the condition is one of continuous slow development of a malignant goitre, rather than a malignant growth superimposed upon a benign one. Ewing, on the other hand, states that the usual clinical history indicates that a long period of benign overgrowth precedes the malignant tumor, and that there are many indications that tumors of the thyroid, as in many other organs, fall into two groups, embryonal and adult, and that each variety includes some forms of adenoma and carcinoma. He thinks that some atypical, usually rapidly growing tumors described as sarcoma, appear to find their true explanation in an embryonal epithelial origin.

*Acute Carcinoma*—In contrast to slow growth of thyroid carcinoma some have described an acute form of cancer. Ewing has observed two very acute cases in young women. Moure and Liébault<sup>41</sup> cite a case in a man of fifty-nine, in whom within three months a large tumor simulating Riedel's woody strumitis developed. In this case, however, it proved to be an infected carcinoma. At the onset he had a severe cold, and they raise the question whether the infection did not stimulate a previously latent cancer. Bouman<sup>7</sup> also mentions acute thyroid carcinoma.

*Rôle of Infection*—Bouman also discusses the relation between infection and the development of thyroid cancer. He quotes Carrel-Billard as follows: "At the Lyon Clinic the patients often observe some infectious disease just about the time of the development of the malignancy. Many times an enlargement of the neck starts after an attack of la grippe." "This influence of infection is real," says Carrel, "we do not believe that it is a mere coincidence." Poncet in the same clinic had observed long before the existence of an intimate relationship between some inflammatory condition of the pharynx or tonsil and certain tumors of the thyroid. De Quervain<sup>15</sup> notes previous inflammation as a factor. Erysipelas, influenza and streptococcic septicæmia are mentioned by Speese and Brown as playing a part in the causation of some cases.

*Age*—Cancer of the thyroid occurs most frequently in patients between 40 and 60, Balfour finding that of 103 cases at the Mayo Clinic, 81.5 per cent were over 40. However the disease is occasionally seen at much younger ages, 3 and 5 years (Ewing), 5, 11 and 16 years (Klose and Hellwig), 17 years (Meleney<sup>52</sup>).

*Trauma*—Trauma has been accorded a place in the etiology of thyroid cancer by several writers<sup>15</sup> In this connection Balfour mentions 7 cases that had been treated by injections of various irritants and by application of absorbents (See Mason's case, developing after strangling)

*Pregnancy*—Many cases are attributed to or aggravated by gestation<sup>16</sup> Speese and Brown cite Kaufman (no reference) as authority for two cases closely associated with pregnancy

*Other Factors*—Various other factors, such as carrying heavy burdens, menstrual congestion, menopause, local atherosclerotic changes in the vessels, and repeated "Einklemmung" of retrosternal nodules with attendant crushing and circulatory disturbances, are given by Klose and Hellwig

*Frequency of Cancer Found in Goitres*—Of 14,456 goitres seen at the Mayo Clinic from January, 1910, to August, 1918, Balfour found that 1.19 per cent showed malignant tumors He states that, as pointed out by Plummer cancer in their experience has never been found in a distinctly and purely hyperplastic gland (exophthalmic goitre) Excluding, then, exophthalmic goitre, of the remaining 6359 cases of goitre, cancer was found in 1.6 per cent In 1921, from the same clinic, Wilson reported that of a total of 16,549 goitres, including exophthalmic, 290 or 1.75 per cent, showed malignant tumors

DeCoucey<sup>14</sup> found in 3640 goitres, of which 1242 were operated on, 16 proven and 8 doubtful carcinomas, giving a total doubtful ratio of about 0.7 per cent

Speese and Brown in 426 lesions of the thyroid found carcinoma in 19 and "sarcoma" in 3, a total percentage of over 5

Simpson found that 4 per cent of all thyroids examined by him microscopically showed malignant disease

Jackson<sup>28</sup> in one series of 100 cases of goitre in Wisconsin, found 4 cases of cancer

John Rogers in 1917 stated that the disease was relatively rare in his experience, as he had records of only 12 cases

Hueck<sup>27</sup> found 10 malignant tumors in 212 cases of goitre operated on (4.7 per cent)

Jungling<sup>20</sup> estimates from clinical observation that 3 to 5 per cent of all goitres are malignant Klose and Hellwig found 20 malignant goitres in 655 operated on (3 per cent) Other recent German figures are as follows Nageli 4.2 per cent Oberst 4 to 5 per cent, Schaedel 3.3 per cent

*Non-occurrence of Cancer in Exophthalmic Goitre*—While Balfour Herbst,<sup>23</sup> and Speese and Brown state that cancer has never been known to develop in a *true* exophthalmic goitre, Ewing states that true tumors may develop in the Graves' thyroid, though rarely He considers it possible that the initial hyperplasia belonging to the general disease passes rapidly into a malignant overgrowth, which thereafter dominates the clinical picture However, many cases of thyroid cancer are complicated by the existence throughout their course, or before the tumor becomes apparent, or at some time during their course, by symptoms of Graves' disease, which may obscure the diagnosis

There were symptoms of intoxication in 26 of Carrel-Billard's 83 cases,<sup>21</sup> and Speese and Brown observed in 5 of their 28 cases the following symptoms

1 Rise in temperature to 38–38.5 to 39° C which may precede the tumor The patient becomes cachectic, and only after the lapse of some weeks is the cause (cancer) demonstrable Fever, "more constantly found in sarcoma" than in carcinoma, is regarded as a symptom of altered thyroid function

2 Symptoms of exophthalmic goitre

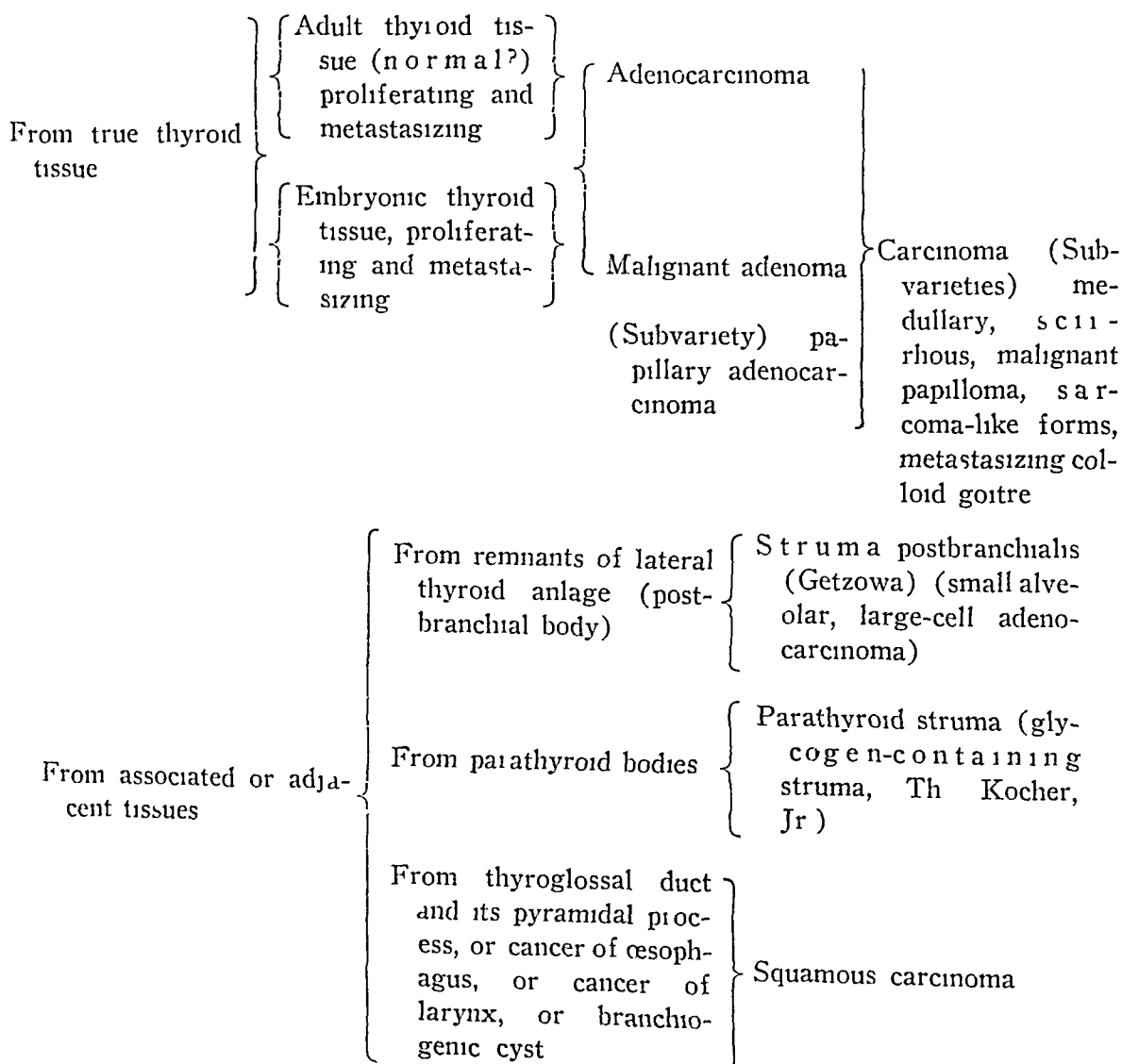
3 Disturbances in nutrition—first loss in weight Urinary disturbances, either increase or decrease, are frequently met

Klose and Hellwig find that in their locality symptoms of Basedow must be regarded as a very frequent and important initial sign of malignant change in a goitre, though they regard this manifestation as being rare elsewhere

Incomplete Basedow symptoms were associated with one case having a small thyroid tumor with bone metastases, reported by Tixier and Duval "

See —In contradiction to other writers, De Quervain is said to have observed more malignant tumors of the thyroid in males. Most writers find it about twice as frequent in females, the following ratios being given: Balfour 65/35, Wilson 69/31, Muller and Speese 60/40, Orcel 14/6, Carrel-Billard 5/3, Delore 4/1, Hueck 6/3.

*Pathological Classification of Malignant Goitres*.—Modern American surgical literature usually considers malignant tumors of the thyroid under practically the one heading of "malignancy," or if an attempt is made to classify them, the classification is confused by retaining such terms as mixed- and spindle-cell sarcoma and small round-cell sarcoma, terms which in most cases could probably better be replaced by the name of some form of carcinoma. The following classification is proposed as an adaptation of Wilson's, arranged to show morphological relationships:



*Frequency of Various Varieties of Malignant Goitre*.—Herbst found that of 207 malignant tumors operated on at the Mayo Clinic, 62, or 29.8 per cent, were carcinoma, 102, or 49.2 per cent, were malignant adenomas, 24, or 11.6 per cent, were malignant papillomas, and 19, or 9.2 per cent, were called sarcomas.

*Clinical Differentiation of Various Varieties of Malignant Goitre*—Kocher (Sr)<sup>21</sup> has given some very suggestive diagnostic points in an attempt to differentiate clinically between the various forms of malignant thyroid tumors. As such differentiations are not commonly found in the English literature, it seems worth while to reproduce them in part here.

1 *Adenocarcinoma, "wuchernde Struma" of Langhans*—"The more a goitre presents itself as a larger, circumscribed mass, prominent on one side in spite of rapid growth, and the more distinctly it retains a certain mobility in spite of increased consistence (often with slight tenderness to pressure), *i e*, the less marked the attachment to surrounding structures still remains after a period of months or even one or two years, so much the more have I reason to think of the wuchernde Struma. The surface may present, also, a regular form. In further support of this diagnosis are the large arterial vessels, at times the large branches of the superior thyroid artery, which may be felt upon the tumor. It is all the more favorable to this diagnosis if marked signs of stasis in the form of dilated subcutaneous veins are not present."

2 *Malignant Adenopapilloma Cylindrocellulari*—"The most characteristic type of this tumor is the goitre which grows slowly, forms tumors of smaller size, after excision recurs only locally, after a certain time results primarily in involvement of lymph-nodes, but possesses no great tendency to produce metastases."

3 *Carcinoma*—"One is always inclined to consider as carcinoma a tumor of the thyroid itself which grows rapidly, is firm and knobby, only slightly movable, presents symptoms of adhesions to the adjacent organs, if there be added thereto early lymph-node involvement, which forms tumors, usually multiple, behind the sternomastoid and from there upwards and downwards."

4 *Parathyroid Struma*—"It seems justifiable to think especially of parastruma when a firm, knobby, usually not very large tumor has developed towards the clavicle (it is however, always unilateral and united with one of the lateral thyroid lobes), and thus is deeply situated, is fairly firmly fixed, has recently developed relatively rapidly on the basis of a slowly growing goitre, and when, together with this increase in growth, marked dyspnoea, hoarseness and dysphagia have appeared with absence or diminution of pain and adenopathy despite signs of increased fixation to the trachea."

*Symptoms and Diagnosis*—In general there are no characteristic *early* symptoms of cancer of the thyroid. The difficulty of early diagnosis is strikingly shown by the fact that at the Mayo Clinic 70 per cent were missed clinically.<sup>22</sup> Rate of growth is not a reliable criterion, for, as stated by Wilson, 'while a sudden increase in rate of growth of a long-standing nodular tumor of the thyroid in a patient more than thirty-five years of age is strongly indicative of malignancy, a slow continuous growth of a nodular tumor may be almost equally indicative of the same condition.' In 46 per cent at the Mayo's the diagnosis of a malignant tumor was *not even considered* until the operation or the pathologist's examination revealed the true condition." Balfour says this figure could be lowered if in the large group of hard or firm adenomas the possibility were regularly noted, but the total percentage of accuracy in diagnosis would thus be lowered, because of the small percentage of such adenomas that are malignant. He mentions the confusing changes in certain enlarged thyroids that are not malignant, especially low-lying adenomas in which consistence is increased by the presence of a considerable deposit of lime salts. He points out the frequent close analogy between benign nodules and malignant masses, in that both remain covered by healthy thyroid tissue until they have reached considerable size. Carcinoma of thyroid almost invariably develops from within outward.<sup>2</sup>

Thus, small areas of carcinoma are sometimes found in the routine pathological examination of adenomas removed at operation.<sup>6</sup> Yet the difficulties of pathological diagnosis in this field are well known, when the cancer has broken down, and especially when it has developed within a cyst, atypical microscopical pictures are often found, not agreeing with the surgical findings.<sup>2</sup> Even nodular enlargement may be absent, as Klose and Hellwig find a whole series of cases with but a uniform swelling of the gland. Hinterstoisser

## CANCER OF THE THYROID TREATMENT

collected 17 cases beginning as diffuse infiltration, and Friedland describes carcinoma without enlargement of the gland<sup>18</sup>

Increased consistence may be produced by the presence of calcified or fibrous benign nodules. Kraus finds that the differential diagnosis from chronic strumitis is most difficult. In both chronic strumitis and cancer there may be fixation, radiating pains and tracheal stenosis, and he doubts whether the sign of Delore and Alamartine (involvement of both sides in chronic strumitis) is regularly present.

Oehler<sup>43</sup> thought in 1919 that he had discovered an additional sign of malignant goitre in the loss of the shadow of the trachea on the roentgenogram, believed to be due to the infiltration of the trachea. However, Klose and Hellwig point out that Pfeiffer has shown this sign to be unreliable, and indicative merely of antero-posterior compression of the trachea (and therefore present at times in benign tumors).

Decreased mobility is only to be demonstrated when the capsule of the thyroid has been infiltrated<sup>70</sup>. In one case the enlarged right lobe moved perfectly well with deglutition, but at operation a large section of œsophagus was found to be involved. The point about fixation is not whether the goitre is so fixed that it cannot freely accompany the trachea upward during the act of swallowing, but whether the goitre can be moved with reference to the trachea or other structures in immediate apposition to it.

Dysphagia, according to Klose and Hellwig, is not a result of pressure, but is due to attachment of the growth to the œsophagus, and is therefore seldom found with benign goitres, and then only when there is growth between the trachea and œsophagus. Actual invasion of œsophageal (or tracheal) lumen is rare<sup>48</sup>. Thus, a stomach bougie can usually be passed smoothly through the œsophagus<sup>33, 48</sup>.

The radiating pains, especially to the distribution of N. occipitalis major, also the second, third and fourth cervical nerves, are not an early symptom<sup>33, 30</sup>. Balfour finds that rarely hoarseness and dysphagia may occur early, and that in the absence of other symptoms, they are suggestive. Recurrent nerve paralysis is the earliest sign of nerve involvement, and occurred in one-third of Schaedel's cases. The changed position of the larynx aids in producing hoarseness by the consequent circulatory changes in the laryngeal mucosa<sup>30</sup>. Laryngological examination may reveal posticus or total paralysis of the laryngeal muscles, or the sabre-sheath stenosis of the trachea, or infiltration of the tracheal wall, in the latter case direct laryngoscopy is said to be dangerous.

Partial or complete palsy of the arm was seen in three cases by Schaedel. Sympathetic paralysis, producing enophthalmos, narrowing of lid aperture, contraction of pupil and paleness on the affected side, with congestion and sweating on the sound side, occurred in two of Schaedel's cases. Pressure on the vagus, leading sometimes to cardiac disturbances, is mentioned by Muller and Speese. Venous stasis and thrombosis are of common occurrence, and growth into veins may occur even with an intact capsule<sup>30</sup>, and even with histologically benign tumors<sup>48</sup>. Klose and Hellwig find that enlargement of the right heart is frequent, and they interpret it as being due partly to the obstruction to the venous circulation, and partly to changes in resistance in the lesser circulation through narrowing of the trachea.

As mentioned above, various toxic changes may be found, such as tachycardia and cardiac irregularities.

Actual cancer cachexia is rare, according to Klose and Hellwig, and loss of weight occurs only as a result of dysphagia, pains, insomnia, etc., or, in the experience of Muller and Speese, chiefly in those cases in which the primary tumor is small and the metastases considerable.

Diagnostic puncture is advised against by Klose and Hellwig, as it is often without positive result in cases of undoubted cancer, and there is at least theoretical danger of disseminating the tumor. They are also opposed to biopsy unless it is to be followed immediately by a radical operation.

*Metastases*.—Bland-Sutton considers that one remarkable feature of thyroid carcinoma is the infrequency with which it disseminates. However, Ehrhardt and Kocher

(cited by Schaedel) and Kraus state that metastases occur in about 90 per cent of the cases. Usually lungs and bones are given as the most frequent sites of metastases, but Schaedel found the following distribution

1 Regional nodes	11 cases
2 Hilal and bronchial nodes	8 cases
3 Lungs	5 cases
4 Bones	4 cases
5 Stomach	2 cases

In this country Herbst at the Mayo Clinic finds that bone metastases are rare, and that the lungs and liver are the most common location of secondary growths. Some have believed that bone metastases may appear at points of hemorrhage following trauma,<sup>29</sup> but, as in other tumors, a true relation to trauma may be questioned.<sup>15</sup> Bone metastases may have a predominating osteoplastic character,<sup>15, 30</sup> and fractures occurring may heal.<sup>15</sup> On the contrary, Aschoff<sup>1</sup> states that the bone metastases have no osteoplastic tendency, destroying the bone like primary central bone tumors, and causing in the spine, for example, collapse with compression myelitis.

The route of metastasis is especially frequently through the blood-vessels, and Graham, in a recent communication,<sup>71</sup> advocates making use of the criterion of local invasion of the blood-vessels to distinguish malignant from benign adenomata. On that basis he has reclassified as benign, 43 adenomata which he had formerly considered malignant.

Ehrhardt<sup>18</sup> gives the following order of frequency of involvement of various organs: Lungs, 129 cases; bones, 66 cases; liver, 36 cases; kidneys, 20 cases; pleura, 16 cases; brain, 12 cases; and other organs, 13 cases.

Occasionally the involved regional lymph-nodes with a small primary tumor may give the clinical picture of Hodgkin's disease or lymphosarcoma of the neck, as in a case seen recently at the Memorial Hospital. Moreover, the tumor may arise in lateral aberrant thyroid tissue,<sup>7</sup> and thus produce one of that numerous group of cases with tumor of the side of the neck in which no clinical diagnosis can readily be made.

Metastasis to the heart, a very rare occurrence, has recently been reported by Eisen,<sup>16</sup> in a case having wide dissemination of the disease.

Hæmoptysis is a frequent result of lung metastasis.

*Complications*—Ulceration of the trachea when invaded by the growth often gives rise to septic pneumonia, usually rapidly fatal.<sup>4, 42</sup> Hemorrhage, œdema of glottis, starvation from dysphagia, and suppuration of the tumor are also causes of death and occasionally pressure due to sudden hemorrhage within the tumor may prove fatal.

*Treatment*—Considerable discrepancy appears in the modern literature as to the relative value of surgery and radiation in the treatment of malignant tumors of the thyroid.

Bland-Sutton states that the very scanty literature in relation to the operative treatment is a clear indication of the hopelessness of such treatment, while in respect to the radiation treatment, A. Kocher,<sup>32</sup> in a recent article, states that the few publications show that the results are not worth publishing.

Perthes, who has constantly observed the effects of rontgen-ray on tumors since 1903 and has compared the results with those of surgery, and who was one of the first to oppose his observations and views to the over-enthusiastic hopes of German clinicians about the results of radiation,<sup>30</sup> has this to say about surgery in carcinoma of the thyroid: "As total extirpation of the thyroid is not permissible, so in most cases a real radical operation is not possible, and as far as I can see, nothing is known of a lasting cure."

## CANCER OF THE THYROID TREATMENT

The experience of Balfour and others<sup>51</sup> indicates that there is no hope of cure by surgery when the growth has progressed sufficiently to enable making a clinical diagnosis, and in fact DeCourcy states that in every case so diagnosed death has been hastened by operation

A Kocher claims 80 to 90 per cent cures, "as in other organs," by surgery in what he terms a *real* early operation, *i e*, before metastasis or growth through the perithyrium. As soon as the above conditions are passed, he says, the prognosis becomes very bad, in fact worse than with malignant tumors of other organs

When one considers the difficulties of making an early diagnosis of cancer of the thyroid and the fact that the correct diagnosis in the real early cases is more commonly made only by pathological examination of a supposed benign adenoma, the fact that many patients, perhaps the majority, with adenomas, refuse operation, and furthermore, when one takes into account the variations in the natural history of cancer of the thyroid, from slow continuous growth of a goitre to rapid enlargement of a preexistent goitre and the very acute type, it must be evident that the attainment of any such percentage of cures of thyroid cancer *in general*, as Kocher claims must, for a long time at least, remain hopelessly utopian. Considering the actual state of the public's knowledge of medical matters and the general profession's lack of training in the clinical diagnosis of tumors, there is no question but that the majority of patients having cancer of the thyroid will continue for a long time in the future, as they have in the past, to fail to reach competent hands until a clinical diagnosis can readily be made, and therefore when it is too late to operate. Therefore the treatment of thyroid cancer may be expected to continue for some time to be the treatment of cases which the best surgeons acknowledge do badly by operation

Let us examine in more detail what some of the results of surgery are. The common view among surgeons is that the best attack on the problem of thyroid cancer is by way of prevention, *i e*, to remove all adenomas, which are considered chief source of carcinoma in this organ<sup>28, 6, 2, 58, 59, 60, 14, 19, 20, 21, 51</sup>. However, actual removal of all adenomas would in many cases be equivalent to total extirpation of the thyroid. The common practice of removing simply the one or two large nodules which are palpable, leaving the numerous other small nodules which are not palpable to proliferate later, accounts for the frequent history of local recurrence. That the early removal of the ordinary benign adenoma is not a sure preventive of "malignant degeneration" is substantiated by Klose and Hellwig's observation of three cases of cancer of the thyroid in which such operations had been done. This contradicts the claims of leading American surgeons. DeCourcy states "Surgery offers 100 per cent cure in adenomata, with mortality of less than 1 per cent"

Excellent results are claimed for surgery in those cases in which no clinical sign of carcinoma is present. Of this group, Balfour reports 70 per cent free from recurrence, even though in many such cases only the removal of one lobe or only the enucleation of an adenoma was done. DeCourcy discovered 12 certain and 8 doubtful cancers in 850 thyroidectomies for adenoma. One had a recurrence and died in 13 months, another after 2 years, one had a recurrence after 2 years but was still living, one was living and



well one year, 4 for two years, and 12 for 3 years. On the other hand, of his 4 cases in which a clinical diagnosis could be made, all died—one in 18 hours, one in 10 days, one in 6 months and one in 9 months.

A Kocher's rather startling figures of 80 to 90 per cent cures in real early operations apparently are based on 10 such cases which he has had under observation, free from recurrence for from 3 to 20 years.<sup>1</sup>

At the Mayo Clinic, Herbst found the following results of operation: no cures in 19 cases of "sarcoma," 5 per cent 5-year cures of 62 cases of carcinoma, 17.6 per cent 5-year cures of 102 cases of malignant adenoma and 33 per cent 5-year cures of 24 cases of malignant papilloma. Encapsulation of the tumor greatly favors freedom from subsequent recurrence, 47 per cent of the encapsulated tumors as against only 26 per cent of the non-encapsulated tumors having remained free from recurrence. Sixteen of the 19 cases of "sarcoma" died within one year after operation, the average post-operative course being 6 months. Forty-eight and four-tenths per cent of the 62 cases of carcinoma were dead. Most (42 per cent) died within one year. Ten per cent of the 102 cases of malignant adenoma died of that disease after operation. Only 2 died within one year after operation, 5 having lived 5 years or more. However, 52 per cent had recurrences, 6 occurring within one year, 13 in the third year and 15 in the fourth year after operation. Twenty-five per cent of the 24 cases of malignant papilloma died of the disease, 4 of these during the first year, one during the third year and one during the fourth year following the operation. Only two cases had reported recurrences, one after 2 years and one after more than 5 years.

Delfour in an earlier report had been able to secure information about 42 cases out of 65 that had been operated on. He reported as follows:

6 per cent + operative mortality

47.6 per cent died from early recurrence

11 per cent had recurrence at the time of his report

Total 64.6 per cent deaths or probable early deaths

Thirty-five per cent had no evidence of recurrence for from one to five years (17 cases) distributed as follows:

3 cases less than one year

3 cases one to two years

4 cases two to three years

1 case three to four years

5 cases four to five years

1 case more than five years

} 10 cases less than three years without recurrence

} 7 cases more than three years without recurrence

Only 14.6 per cent of those having diffuse involvement were alive without recurrence. In the 46 per cent in which no clinical signs of cancer were found, about 70 per cent were free from recurrence, although in this group total thyroidectomy was rarely performed, usually only the removal of the affected lobe or the enucleation of an adenoma having been done.

Crotti quotes the statistics of Brown-Potter in 1900, giving the total mortality of operation for thyroid cancer as 72 to 85 per cent, according to the stage of development of the tumor. He also gives Madelung's figures: that author in 1900 reported 100 cases. In 59 death occurred within one month after the operation, in 39 recurrence took place within six months, and in the remaining two death occurred later.

Muller and Speese in 1906 placed the mortality, including deaths from operation and from speedy recurrence, at at least 70 per cent.

Jackson in June, 1924, reported that in one series of 100 cases of goitre operated on during 1923 at the Jackson Clinic, there had been 4 cases of cancer, of whom 3 were already dead.

## CANCER OF THE THYROID TREATMENT

De Quervain is said<sup>33, 43</sup> to give the immediate mortality after radical operation as 50 per cent

A Kocher, who claims 80 to 90 per cent cures by real early operation, states that when the conditions for what he considers an early operation have been passed, the prognosis becomes very bad, with an immediate mortality from operation of 10 to 20 per cent, and recurrences in 84 per cent. He finds that "sarcoma" recurs in 100 per cent, malignant papilloma in 33 per cent, other cancers in 90 per cent.

Klose and Hellwig, in a recent report, state that the question of the value of radiation in the treatment of thyroid cancer is certainly worthy of being thoroughly investigated, since statistics indicate at present that even with the modern refined operative technic the immediate operative mortality is 30 to 66 per cent and the curative results of the most radical operation very poor. Of 20 cases which they operated on, the 18 who had no radiation were all dead within a year.

Among the dangers of operation Balfour mentions œsophageal fistula, tracheal collapse, injury to nerve supply of the laryngeal muscles, secondary œdema of tracheal mucosa and secondary hæmatomas.

Sudeck<sup>44</sup> has never succeeded in completely removing a cancer of the thyroid without total extirpation of the gland, thereby injuring the parathyroids, and he experienced one such case which died of tetany. In view of results which he has seen following radiation of malignant tumors of the thyroid, he therefore makes no attempt at surgical treatment, but considers it quite justifiable to treat every case by roentgen-ray.

*Treatment by Radiation*—Leading German radiologists agree that carcinoma of the thyroid is remarkably sensitive to radiation. Peithes also states that "sarcoma" of the thyroid is as favorable for this form of treatment as sarcoma of lymph-nodes or tonsils, though Schaedel's experience leads him to think that "sarcoma" of the thyroid does not react well to radiation "whether of spindle-cell, polymorphous-cell or lymphoid-cell type." Only one of his cases of "sarcoma" showed softening and regression of the tumor but he admits that the cases of "sarcoma" came too late and in poor general condition.

Schaedel's report in 1922 is one of the most important recent contributions to this subject. He considers that thyroid carcinoma is so radiosensitive that a therapeutic-diagnostic test by radiation is of great value. If the tumor is a carcinoma, according to Schaedel, one can tell in two to three weeks after radiation merely by the rapid change that takes place, the tumor becoming softer and smaller. He finds that the primary tumor appears more responsive than the metastases. In all but one case he secured permanent regression of the primary tumor. The one case having local recurrence had only one series of roentgen-ray treatments. However, even the secondary tumors showed some response, in 3 out of 5 cases of lung metastasis the shadows in the roentgen film became so reduced that they could no longer have been recognized as metastases. Lymph-node and bone metastases were no longer demonstrable.

He reports 15 cases of carcinoma of the thyroid treated by roentgen-ray. Of these 11 were inoperable, 7 being so advanced that one would have given a prognosis of only weeks or months. Of these 7 hopeless cases, 2 died within 2 weeks of intercurrent diseases (one of pneumonia, and one of sepsis from perforation of the œsophagus), but the other 5 averaged one and three-quarter years before dying of metastases, living 8, 10, 13 and 17 months in good health.

Of the four less hopeless inoperable cases one died quickly of brain metastasis, one lived three and one-fourth years, going for periods of 13 and 9 months without treatment and giving birth to a child, one lived  $3\frac{3}{4}$  years, dying at the age of 75 of "old age," and one lived  $7\frac{1}{2}$  years, dying at the age of 83 of "old age."

Of the 4 operable cases one had lived 4 years, one for  $3\frac{1}{2}$  years and 2 for 2 years. Grouping his cases according to the thoroughness of their treatment, he reports that only 6 cases were treated as completely as desired, and that of these 5 were cured, the one who died surviving 10 months to die during an operation done because of an

attack of asphyxia. In his sixth cured case he gives all credit to the operation, which was a complete removal, only one series of roentgen treatments having been given. He recommends prophylactic raying of the regional and hilar lymph-nodes, and in this point is in disagreement with Jungling,<sup>2</sup> who fears the deleterious systemic effects of such radiation of areas not yet demonstrably involved.

Jungling cites the case of a woman of 73 who had a long-standing goitre which had been rapidly growing for 3 months. It was nodular, firm and fixed, the circumference of the neck being 50.5 cm. Using four converging fields for roentgen treatments, to obtain 100 per cent depth dose, he found that after 7 weeks the tumor disappeared. However, 3 weeks later a metastasis to the left hip caused her death. He cites another case, a woman of 43, who had a goitre 1½ years, with recent hoarseness and dyspnoea, presenting a nodule the size of an apple on the right side of her neck. After giving two doses two months apart (63 to 70 per cent depth dose) she became clinically healed. He states that many operations intended to be radical must perforce be left incomplete, but that nevertheless such cases still offer good prospects with post-operative radiation, and that this fact led Perthes to recommend that in doubtfully operable cases as much as possible be removed by operation and the site be radiated afterward. He warns of the danger of early oedema of the larynx following radiation, when compression is exerted by large inoperable tumors, and advises against treating the patients as ambulatory cases. He agrees with Schaedel's recommendation that tracheotomy be not attempted when asphyxia threatens. Schaedel feels that tracheotomy in most such cases is ineffective, because the compressed place is usually too deeply situated, and even when the site of compression is above the sternum, the tumor must first be cut through. Schaedel recommends incision down to the tumor and "unfolding" the trachea by exerting traction upon the masses encircling it, thus quickly permitting restoration of respiration, then freeing the trachea from the encircling masses by resection of the middle and lateral parts of the gland, followed by primary closure.

Sudeck thinks that more extended observation will be required to determine whether there is a difference between the various types of malignant tumor of the thyroid in their reaction to roentgen therapy, but at present he is of the opinion that they are all especially favorable for this form of treatment, while for surgery they form a very unsatisfactory chapter. He advises radiation, therefore, in all cases, with no attempt at surgery. Of six of his cases, one of "sarcomatoma" appeared to have a lasting cure, 3 of carcinoma of alveolar structure were locally healed, but died of metastases, while of 2 cases not proven by section and who were still under treatment, one had shown rapid and one a slow regression.

Perthes' opinion in favor of radiation is based not only upon his own rich experience, but also upon answers which he had obtained from all German and Austrian surgeons to whom he had sent questionnaires (Holzknecht<sup>20</sup>).

Holfelder<sup>2</sup> finds that thyroid carcinoma is sharply at variance with other surgical carcinomas in its radiosensitiveness, and offers an absolutely good prognosis, provided a correct technic of radiation is carried out. In 3 cases, despite incomplete operative removal, a certain and complete lasting cure had been obtained with roentgen therapy.

Werner<sup>4</sup> recommends roentgen treatment for the diffuse forms, radium for circumscribed forms, or for tumors in which several distinct nodules exist. He was undecided at the time of his report (1923) whether the interstitial method of radium application offered distinct advantages over the external radiation. Regression, he finds, is not rapid, in the majority of cases, but takes place within a few weeks, and there may be complete disappearance of the tumor. He states that even when the tumor is substernal, with distinct tracheal compression, a result is possible. As to the duration of the results in general, he claims cures of 3 to 4 years' standing. He warns against using large doses at a sitting, stating that rapid resorption of the thyroid tissue of the tumor may lead to severe thyrotoxic symptoms. He considers that danger of cachexia strumipriva also exists.

## CANCER OF THE THYROID TREATMENT

Klose and Hellwig think that as long as a malignant goitre is operable, an operation should be done, and that while the goal should be total extirpation of the thyroid (contrast Perthes' views), if it is possible to carry out proper post-operative radiation one may be content with a less nearly complete operation. They state that those who rely chiefly on the surgical treatment remove the primary tumor, even in the presence of metastases (von Eiselsberg, Ehrhardt and Kocher are said to take the same stand). They point out that recently a movement in favor of the radiation treatment of malignant goitre has begun similar to the movement with respect to uterine carcinoma. While all their cases who had only the operation died within a year, the two remaining cases who went 3 to 4 years free from local recurrence and in the best state of general health had an operation that was undoubtedly incomplete, but was followed by rontgen-ray treatment with a technic assuring a homogeneous distribution of 90 per cent of the skin erythema dose throughout the tumor. It is their view that carcinoma of the thyroid belongs in that group of carcinoma which responds with remarkable regularity to the lowermost limit (85 to 90 per cent) of the skin erythema dose. This point is especially important, they feel, because the part of the tumor which cannot be removed by an operation is next to the trachea and with an exact and homogeneous dose of radiation within the above limits the trachea need not be injured. Their technic consists of using Holfelder's Felderwähler, applying the radiation to two fields obliquely from the right and left to the outstretched neck in such a way that the central beams cross close behind the trachea at an angle of 140 to 150°. The distance from target to skin is 70 cm, the filtration 0.5 mm zinc, and the voltage is equivalent to a spark gap of 39 cm. This dose is repeated after 3 months and again after a further interval of 6 months.

Weber<sup>25</sup> reports one case rejected elsewhere as inoperable carcinoma of the thyroid, presenting marked dyspnoea, who received 3 skin erythema doses, using 3 mm of aluminum filter apparently in divided doses. Within 8 days regression occurred, and dyspnoea subsided. No deleterious results were seen, and in 3 months the patient was in complete health, the circumference of the neck having been reduced from 38½ to 34 cm.

A remarkable case is reported by Estor, Rocca and Parès<sup>17</sup>. A woman of 45, who had first been operated on 12 years before for a benign tumor of the thyroid, and again 5 years before, presented a mass the size of a fist on the right side of her neck and extending retrosternally. Intense dyspnoea, cough and dysphagia were present. Biopsy showed a typical epithelioma of the thyroid. By the use of tubes and needles containing radium they secured a survival for 3 years in this patient, who to all appearances was rapidly progressing to a fatal outcome. They did not secure complete regression and they account for their failure to do so in part by the substernal prolongation of the tumor, and the proximity of the carotids, which contra-indicated heavier treatment. Asphyxia disappeared in 24 hours after the use of the tubes, and in 3 days after the use of the needles.

Pfahler<sup>46</sup> records 10 cases treated by rontgen-ray and radium. He concludes that prompt post-operative rontgen therapy should be used, that if a diagnosis of carcinoma can be made without operation a reasonably good hope of success can be offered by radiation that recurrences can be made to disappear, but that definite metastases are not likely to be controlled in late cases, and advises radium for a definitely localized tumor or when the tumor ceases to respond to rontgen-ray.

Crile<sup>12</sup> describes one case with an advanced carcinoma, in which a decompression operation was done followed by rontgen treatment. Within 5 months the tumor regressed so much that it could no longer be palpated, and the patient had complete relief from choking spells and local discomfort.

Heverdahl<sup>13</sup> reports that of 8 cases of malignant goitre treated with radium (applied both externally and internally to the tumor in tubes), 5 were temporarily improved, but that in 3 no good effect was seen.

McWilliams<sup>22</sup> cites the case of a girl of 18 with a tumor of 3 years' duration, operated on twice, complete removal being accomplished the second time. This was

followed by rontgen treatment, and the patient had remained well  $2\frac{1}{2}$  years at the time of his report

Balfour states that when a clinical diagnosis of carcinoma of the thyroid can be made, as a rule it is much better to advise radiation, and that the operation for the relief of pressure often has dubious results

According to Herbst, radium or rontgen-ray or both are now routinely used at the Mayo Clinic in conjunction with surgery in all operable malignant thyroid tumors, and in certain inoperable cases. Radium, he states, has not been used long enough in their experience, so that accurate deductions as to its value can be made. Boothby states that in the cases in which carcinoma is recognized too late for complete surgical removal, radium and rontgen-ray have been found of value in checking the progress of the malignancy and in prolonging life

A Kocher, despite his assertion that the paucity of literature on the radiation treatment indicates that the results have not been worth publishing, admits in the same article that it is his rule to give radiation after every operation on a malignant goitre, also to every inoperable case. He considers it dangerous to make such assertions as those of Sudeck and Schaedel regarding the peculiar radiosensitiveness of struma maligna, for fear that it may lead to withholding from operation many cases that could be cured by surgery. He does admit that radiation seems to have a good effect on certain cases and delays recurrences and metastases

Crotti in the 1918 edition of his book classed treatment by radiation along with tracheotomy as an important palliative form of treatment

Beck<sup>2</sup> in a recent report from the Kiel Surgical Clinic, states that he has been unable to confirm the absolutely good prognosis claimed by Holfelder, Schaedel and others, nevertheless regards the results of radiation as very gratifying. Of seven cases three went for periods of 4, 3 and 2 years completely free from evidence of disease, the fourth case had a recurrence in the submental region which did not regress with rontgen treatment but had not increased in size for 9 months, another case regained the use of his voice, which had been lost as a result of recurrent paralysis, and two cases responded only temporarily

#### MEMORIAL HOSPITAL RESULTS

An investigation of cases of cancer of the thyroid treated at the Memorial Hospital in recent years was suggested by the casual observation that a number of cases had accumulated who, having been referred here for post-operative radiation, had remained well for periods of two to four years and longer. It seemed desirable to inquire more closely into the history and treatment of these cases, and to compare their course with that of the cases that had not done so well, in order to ascertain whether any facts might thus be brought to light which could have any bearing on prognosis or treatment. Another matter for inquiry was the question of the probability of malignant changes occurring in adenomas. The literature bearing on this point has been reviewed in part in the preceding portion of this paper. Marine and Kimball, in advocating the use of iodine to prevent the appearance of goitre, a procedure which is gaining wide acceptance to-day, have implied that by thus preventing the development of adenomas carcinoma of the thyroid would be largely prevented, for, they state, "probably 90 per cent of the malignant tumors of the thyroid arise from these adenomas"<sup>26</sup> Thirty-three cases of cancer of the thyroid were available for this analysis. (Twelve others were excluded only because of lack of sufficient data.)

## CANCER OF THE THYROID TREATMENT

Pathological reports were available in 19, as follows Adenocarcinoma in 12, carcinoma in 3, diffuse round-cell carcinoma in 1, metastatic thyroid adenocarcinoma in the ilium in 1, "round-cell sarcoma" in 1, and "small spindle-cell fibrosarcoma" in 1 The last two named probably should have been designated as carcinoma

Of the 33 cases, 10 are now living, 19 are dead, and 4 were lost track of (after 6 months, 9 months, 3 years and 3 years, respectively)

Of the 10 living cases, 7 show no evidence of disease at the present time The shortest period of freedom from recurrence in this group is 2 years and 2 months, the longest, 7 years and 11 months, and 6 cases have remained free from evidence of the disease for over 3 years

It is a rather striking fact that of the 10 cases now alive, 9 had an operative removal of the tumor done from 2 weeks to 3 months before coming to this hospital (except one case, who was operated on by Doctor Quick 2 weeks after admission), and in 7 of these, as far as one can judge from the records, the operation was apparently a complete removal of all the gross tumor It is also noteworthy that of these 7 cases in which an apparently complete removal of the tumor was accomplished before radiation was begun, all but one belong now to the group free from evidence of disease, and that the other case of the 7 who are now free from evidence of disease also had an operation which was, however, apparently incomplete

Of the 10 living cases, the 3 which are not free from evidence of disease, have all shown definite improvement following radiation One had an apparently incomplete operation, one an apparently complete removal, and the other was not operated on The one who had the apparently complete operation improved and remained free from evidence of the disease for two years, and then developed a pea-sized recurrence attached to the anterior edge of the sternomastoid This is now under treatment, and is showing very satisfactory regression

No fixed conclusions can be drawn from a study of only 33 cases of such a variable disease as cancer of the thyroid, nevertheless, it has been of interest, and perhaps of some significance, to compare the foregoing living cases with those who died Here we find that of the 19, while one lived over 6 years after first coming to this hospital, dying of cancer of the stomach, and one lived  $5\frac{1}{2}$  years to die of cancer of the breast, 5 showed only temporary improvement, 11 were unimproved, and one was perhaps made worse by the treatment There is no such striking coincidence as in the living cases between cases operated on and cases improved, for we find that of the 5 cases operated on with a complete removal of the tumor 3 weeks to 10 months before coming to this hospital (excluding another case who had been operated on 9 years before), 2 were temporarily improved, 2 were unimproved, and 1 was perhaps made worse by treatment here Two cases had what was known to be an incomplete operation In one, this was done for a supposed colloid goitre 2 months before the patient entered this hospital The pathological report was "round-cell sarcoma" Following radiation the thy-

roid region became and remained free from evidence of disease for  $5\frac{1}{2}$  years, but after 4 years a breast tumor developed which at first responded to radiation, but later infiltrated the entire breast. Sections from the breast tumor showed "small foci of small cells," and it remained uncertain whether it was a primary breast tumor or a metastasis from the thyroid. She also had evidence at that time suggesting lung metastasis. Another case had an operation elsewhere one month before coming to this hospital. The operation was apparently incomplete. An excision of the right lobe had been done, but the operation was followed immediately by an increase in the size of the goitre. However, after two years she became free from evidence of disease locally, and lived for 6 years, dying then of cancer of the stomach apparently an independent tumor.

Of the 19 cases now dead 11 never were operated on. Three of these showed temporary improvement, and 8 were unimproved.

The following table summarizes the outcome in all the cases, separating the cases operated on from those not operated on.

Number of cases	Operation	No evid. of disease to date or when lost track of or at death			Improved			Unimproved			Made worse	No information
		Living	Lost track of	Dead	Living	Lost track of	Dead	Living	Lost track of	Dead	Dead	Lost track of
16	Complete	6	2		1		2			3	1	1
4	Incomplete	1		2	1					1		
13	None				1	1	3			8		
33	Total	7	2	2	3	1	5			11	1	1

The methods of treatment used have varied a great deal, depending upon the indications of the individual case and also, because of changes in technic as new methods have developed. In general, in the group treated "prophylactically" following removal of the tumor external radiation with either roentgen-ray or the radium pack has been used. With roentgen-ray the technic has of course changed greatly in the past few years. Whereas formerly a long series of small doses of comparatively feeble penetrating power was employed the shift in recent years has been toward the use of fewer doses of more intensive shorter wave-length therapy. When definite recurrences have developed, or in those cases that had not been operated on, in many instances the implantation of bare capillary glass tubes containing emanation or the insertion of needles containing radium element or emanation directly into the tumor was practised.

The less favorable anatomical relations of several of the cases that did not survive is reflected by the number of other procedures that were found necessary as attempts to prolong life, namely, tracheotomy in 3 cases, with immediate fatality in 2, and gastrostomy in 2 cases.

Most of the deaths occurred at home or in other institutions, so that the exact mode of death of several cases does not appear on our records.

## CANCER OF THE THYROID TREATMENT

The most common terminal symptoms noted are dyspnoea and cough, due to either lung metastases, or compression or infiltration of the trachea, or both. Two cases died in acute asphyxia following unsuccessful attempts at tracheotomy. Infection and hemorrhage proved fatal in one case. Two had marked dysphagia. Others showed chiefly weakness and cachexia.

As regards metastases, positive evidence was found in a surprisingly small number. Of the living cases there are only one certain and two questionable instances of metastases to cervical nodes, and no definite evidence in any of lung or bone metastases. Of the dead cases, 3 showed metastases to cervical nodes, 5 to the lungs, and one to the ilium, while 2 had questionable lung involvement, and one had a breast tumor which may or may not have been secondary to the thyroid tumor.

It is interesting to note that the average age of the cases that are now living was 12 years less than that of the dead cases (44.3 vs. 56.3 years). The age limits of the living cases were from 20 to 67, while those of the dead cases were 32 to 78.

The living cases on the average appear to have come here much earlier in the course of their disease. Counting the first appearance of a lump in the thyroid as the beginning of the disease, the living cases *on the average*, had symptoms for 5 years and 7.4 months, the dead cases, 7 years and 9.7 months. The long average duration in the dead cases, however, is raised chiefly by 3 cases of 25, 35 and 43 years' duration.

These long durations may seem to support the statement of Marine, Kimball and others that a large percentage of thyroid carcinomas develop in long-existing adenomas, and to argue for the iodine treatment, especially in endemic goitre districts to prevent the appearance of such tumors (if that is possible), and for the early eradication of all such tumors as a part of the preventive treatment of precancerous conditions.

On the average the living cases have survived nearly three times as long as the dead cases after coming to this hospital (3 years, 10.4 months and 1 year, 4.8 months, respectively).

### SUMMARY

1. Varying reports in the recent literature of the treatment of cancer of the thyroid and some interesting points brought out in a study of 33 cases at the Memorial Hospital, justified a partial review of the literature in order to bring together and emphasize some of the more remarkable features of this disease and the conflicting statements of various writers on the subject.

2. The interpretation of thyroid tumors requires special standards not applicable elsewhere. Malignant qualities of a thyroid tumor must be judged from the clinical and gross anatomical features, rather than from the microscopical aspect.

3. Probably all malignant tumors of true thyroid origin are epithelial, the occurrence of true sarcoma of the thyroid in man is doubtful.

4. Carcinoma of the thyroid is frequently, and perhaps with few exceptions preceded by previous goitre.



5 Some observers find that carcinoma of the thyroid begins almost exclusively in the right lower pole

6 There is a very acute form of cancer of the thyroid

7 Various infections, irritants, traumata, circulatory disturbances, etc., have been assigned etiological roles by different observers

8 Cancer of the thyroid is most common between the ages of 40 and 60, but has been seen in very young children

9 One to five per cent of all goitres operated on are malignant, according to different observers

10 Cancer of the thyroid is very rare in true exophthalmic goitre, but may occur in that condition

11 Thyrotoxic symptoms, on the other hand, are common, and in certain clinics are regarded as a very important initial sign of malignant change in a goitre

12 Females have cancer of the thyroid about twice as frequently as males

13 Kochei's clinical distinctions between various forms of malignant thyroid tumors are given in part

14 There are no characteristic early symptoms of cancer of the thyroid

15 The differentiation from solid adenomas and from chronic strumitis of the Riedel type is most difficult clinically

16 Fixation should be determined by the degree of mobility of the tumor *with reference to* the trachea or other apposed structures, and not by its ability to move up and down *accompanying* the trachea during the act of deglutition

17 Metastases are common, their route of dissemination is unusually frequently by the blood stream, and bone metastases may show either osteoplastic or osteoclastic properties

18 When a clinical diagnosis of cancer of the thyroid can be made, it usually means that the disease has progressed so far that cure by surgery is impossible, and in fact, the case may be made worse by operation

19 The mortality from operations for cancer of the thyroid is very high

20 Leading German radiologists agree that carcinoma of the thyroid is remarkably radiosensitive

21 Reports by surgeons and radiologists on the treatment of cancer of the thyroid in the recent literature are given

22 A report is made on 33 cases of thyroid cancer that have been treated at the Memorial Hospital

23 Ten cases are now living, 7 free from evidence of tumor for from 2 years and 3 months to 7 years and 11 months. The other 3 living cases show definite improvement

24 The living cases were 12 years younger, on the average, when their treatment at Memorial Hospital was begun, than those who died, and already they have lived three times as long after coming to the hospital than did those who died

25 On the basis of this study it would seem best to advise early complete removal of all nodular tumors of the thyroid. While this procedure does not

## CANCER OF THE THYROID TREATMENT

guarantee that other similar tumors will not appear later in the remaining portions of the gland, it will discover many unsuspected carcinomas. If carcinoma is so discovered, prompt and thorough post-operative radiation with roentgen-ray or the radium pack should be used. If a clinical diagnosis of cancer of the thyroid can be made, operation should be avoided, and thorough radiation, either by heavy roentgen-ray or external radium applications, or these combined with an efficient form of interstitial radium application should be carried out.

### REFERENCES

- <sup>1</sup> Aschoff, L. *Pathologische Anatomie*, 5te Auflage, Gustav Fischer, Jena, 1921, vol. II, p. 977.
- <sup>2</sup> Balfout, D. C. *Cancer of the Thyroid Gland*, *Medical Record*, vol. cxiv, p. 846, (Nov. 16, 1918).
- <sup>3</sup> Beck, A. *Die Bedeutung und die Probleme der Strahlentherapie in der Chirurgie unter besonderer Berücksichtigung der Erfahrungen der Kieler Chirurgischen Klinik*, *Strahlentherapie*, vol. xix, p. 199, 1925.
- <sup>4</sup> Bland-Sutton, Sir J. *Tumors Innocent and Malignant*, P. B. Hoeber, New York, 1922, pp. 592-594.
- <sup>5</sup> Bloodgood, J. C. *Adenoma of the Thyroid Gland*, *Surg., Gyn. and Obst.*, vol. II, p. 121, (Feb.), 1906.
- <sup>6</sup> Boothby, W. M. *Diagnosis and Treatment of the Diseases of the Thyroid Gland*, in *Oxford Medicine*, 1921, vol. III, p. 883.
- <sup>7</sup> Bouman, H. A. H. *The Early Diagnosis of the Malignant Thyroid, Especially Carcinoma*, *Minn. Med.*, vol. III, p. 105, (March), 1920.
- <sup>8</sup> Bower, J. O., and Clark, J. H. *The Resistance of the Thyroid Gland to the Action of Radium Rays*, *Amer. J. of Rontgenology*, vol. x, p. 632, (Aug.), 1923.
- <sup>9</sup> Bower, J. O., and Clark, J. H. *A Preliminary Report of the Action of Buried Radium on Diseased Thyroids in Man*, *Amer. J. of Rontgenology*, vol. x, p. 875, (Nov.), 1923.
- <sup>10</sup> Carrel, A. *Le Goitre Cancereux*, J. B. Ballière et Fils, Paris, 1901, p. 252.
- <sup>11</sup> Chambers. *Arch. Middlesex Hosp.*, 1909, vol. xv, p. 29 (Cited by Speese and Brown).
- <sup>12</sup> Crile, G. W. *The Thyroid Gland*, W. B. Saunders Co., Philadelphia, 1923, p. 264.
- <sup>13</sup> Crotti, A. *Thyroid and Thymus*, Lea and Febiger, Philadelphia, 1918.
- <sup>14</sup> DeCoursey, I. L. *Cancer of the Thyroid*, *ANNALS OF SURGERY*, vol. lxxx, p. 551, (Oct.), 1924.
- <sup>15</sup> De Quervain. *Lehrbuch der Chirurgie*, Bd. 1, p. 432, (Cited by Speese and Brown).
- <sup>16</sup> Eisen, D. *Malignant Tumors of the Thyroid. An Analysis of Seven Cases with a Study of the Structure and Function of the Metastases*, *Am. J. Med. Sc.*, vol. clxx, pp. 61, (July), 1925.
- <sup>17</sup> Estor, M., Rocca, Mlle., et Pares, M. *Epithelioma du corps thyroïde traité par la radiumtherapie*, *Bull. de la Soc. des Sciences Med. et Biologiques de Montpellier*, vol. v, p. 120, 1923-4.
- <sup>18</sup> Ewing, J. *Neoplastic Diseases*, 1st ed. W. B. Saunders Co., Philadelphia, 1919, pp. 869-888.
- <sup>19</sup> Graham, A. *Diseases and Pathology of the Thyroid Gland*, in Crile *The Thyroid Gland* (see above), p. 46.
- <sup>20</sup> Graham, A. *Malignant Epithelial Tumors of the Thyroid*, *Surg., Gyn. and Obst.*, vol. xxxix, p. 781 (Dec.) 1924.
- <sup>21</sup> Graham, A. *Malignant Tumors of the Thyroid Epithelial Types*, *ANNALS OF SURGERY*, vol. lxxvii, p. 30 (July) 1925.
- <sup>22</sup> Greensfelder, L. and Bettman, R. B. *Carcinoma in Lateral Aberrant Thyroid Gland*, *J. A. M. A.*, vol. lxxviii, p. 797 March 18, 1922.

- <sup>1</sup> Herbst, W P, Jr Malignant Tumors of the Thyroid, *ANNALS OF SURGERY*, vol LXIX, p 488, (Apr ), 1924
- <sup>1</sup> Heyerdahl, S A Radium Treatment of Changes in the Thyroid Gland, *Acta Radiologica*, vol 1, p 207, Sept 20, 1921
- <sup>~</sup> Holfelder, H Die Erfahrungen mit der Rontgentherapie der malignen Tumoren an der Schmiedenschen Klinik, *Strahlentherapie*, vol XV, p 726, 1923
- <sup>9</sup> Holzknecht, G Schilddrüsenkarzinom und Rontgenbestrahlung, *Wien klin Wochenschrift*, vol XXXII, p 419, April 24, 1924
- <sup>21</sup> Hueck, H Ein Beitrag zur Kenntnis der Struma maligna, *Arch f klin Chir*, vol CXXX, p 45, Aug 7, 1924
- <sup>22</sup> Jackson, A S Conclusions Based on a Study of 4000 Cases of Goitre, *ANNALS OF SURGERY*, vol LXXX, p 840 June, 1924
- <sup>~</sup> Jungling, O Rontgenbehandlung chirurgischer Krankheiten, *S Hirzel*, Leipzig, 1924, p 288
- <sup>30</sup> Klose, H, and Hellwig, A Die Struma Maligna, *Klinische Wochenschrift*, vol 1, p 1687, Aug, 1922
- <sup>31</sup> Kocher T Zur klinischen Beurteilung der bösartigen Geschwulste der Schilddrüse, *Deutsche Zeitschrift für Chirurgie*, vol XCI, p 197, Dec, 1907
- <sup>~</sup> Kocher A Article, in *Zweifel-Punkt Klinik der bösartigen Geschwulste*, S Hirzel, Leipzig 1924 vol 1, p 792
- <sup>1</sup> Kraus, F Ein Fall von Struma Maligna, *Medizinische Klinik*, vol XX, p 523, Apr 20, 1924
- <sup>1</sup> Luinghaus, T Über die epithelialen Formen der malignen Struma *Virchow's Archiv*, vol CLXXXIX, p 69 1907
- Marine, D, and Johnson, A A Experimental Observations on the Effects of the Administration of Iodin in Three Cases of Thyroid Carcinoma, *Arch of Int Med*, vol XI, p 288, March 15, 1913
- <sup>6</sup> Marine D, and Kimball, O P The Prevention of Simple Goitre in Man, *J A M A*, vol LXXVII, p 1068, Oct 1, 1921
- Mason, J T Carcinoma of the Thyroid, *Surg Clinics of North Amer*, vol IV, p 1121, Oct, 1924
- <sup>25</sup> McWilliams, C A Carcinoma of Thyroid, *ANNALS OF SURGERY* vol LXX, p 787, June, 1917
- <sup>9</sup> Melenev, I L A Metastasizing Malignant Tumor of the Thyroid, *ANNALS OF SURGERY*, vol LXXVI p 684, Dec, 1922
- <sup>10</sup> Meyer, H *Strahlentherapie*, vol XVI, p 1110, (1924)
- <sup>41</sup> Moure, P, and Liebault, G Cancer aigu du corps thyroïde, *Revue Hebdomadaire de Laryngologie, d'Otologie et de Rhinologie*, vol XXXII p 337, Sept 16 1911
- <sup>42</sup> Muller, G P, and Speese, J Malignant Disease of the Thyroid Gland *Univ of Penna Med Bulletin*, vol XIX, p 74, June, 1906
- <sup>43</sup> Oehler, J Ein weiteres diagnostisches Merkmal der malignen Struma *Zentralblatt f Chirurgie*, 1919 p 536
- <sup>44</sup> Pemberton, J de J The End-results of Surgery of the Thyroid Gland, *Arch of Surg*, vol VII, p 37, July, 1923
- <sup>45</sup> Perthes, J Zur Biologie und Klinik der Rontgentherapie der chirurgischen Krebse, *Strahlentherapie*, vol XV, p 708, 1923
- <sup>46</sup> Pfahler, G E The Treatment of Carcinoma of the Thyroid by the Rontgen-rays and Radium, *Amer Journ of Rontgenology*, vol IX, p 20, 1922
- <sup>47</sup> Rogers, J Carcinoma of the Thyroid, *ANNALS OF SURGERY*, vol LXXI p 222, Aug, 1917
- <sup>48</sup> Schaedel, W Über Struma Maligna, *Munchener medizinische Wochenschrift*, vol LXIX, p 1282, Sept 1, 1922
- <sup>49</sup> Sielmann, R Rontgentherapie bei Basedow, *Strahlentherapie*, vol XI, p 453, 1923

## CANCER OF THE THYROID TREATMENT

- <sup>53</sup> Simpson, B T Pathology of Goitre, Surg Gyn and Obst vol xxviii p 153, Feb, 1919
- <sup>54</sup> Spence, J and Brown, H P The Malignant Degeneration of Benign Tumors of the Thyroid Gland, ANNALS OF SURGERY vol lxxiv, p 684, Dec, 1921
- <sup>55</sup> Sudeck, P Über die Behandlung des Morbus Basedowii und der Struma Maligna mit Röntgenstrahlen, Deutsche med Wochenschrift vol xlv, p 1104, 1918
- <sup>56</sup> Trotter, W Early Clinical Types of Certain Diseases, The Clinical Journal (London), vol xxxii, p 399, Sept 30, 1908
- <sup>57</sup> Tixier, L and Duval, H Syndrome de Basedow incomplet chez une malade ayant une petite tumeur thyroïdienne avec metastases osseuses, Bull et Mem de Soc méd des Hop de Paris, vol xlv, p 874, June 10, 1921
- Wchei, H Unsere röntgentherapeutischen Erfahrungen 1920-22, Strahlentherapie vol xv, p 323, 1923
- <sup>58</sup> Werner, R Über die Behandlung chirurgischer Karzinome und Sarkome mit radio-aktiven Substanzen, Strahlentherapie, vol xv, p 743, 1923
- <sup>59</sup> Williams, J G X ray Therapy of the Thyroid Gland, N Y Med J, vol cxviii, p 480, Oct 17, 1923
- <sup>60</sup> Wilson, L B Malignant Tumors of the Thyroid, ANNALS OF SURGERY, vol lxxiv, p 129, Aug, 1921, or Coll Papers Mayo Clinic, vol xii, p 376, 1920
- Wilson, L B Illustrative Cases of Malignant Tumors of the Thyroid, Surg Clinics of No Amer, vol 1, p 1291, Oct 1921
- <sup>61</sup> Wilson, L B Malignant Tumors of the Thyroid (article), in Oxford Medicine, 1921, vol iii, p 873
- <sup>62</sup> Wolff, G Ein Beitrag zur Lehre von den epithelialen Geschwulsten der Schilddrüse Beiträge zur klinischen Chirurgie vol cxvi p 56, 1920
- <sup>63</sup> Wright, F R Carcinoma of the Thyroid Extending into Mediastinum and Spinal Canal, The Clifton Medical Bulletin, vol ix, p 3, March, 1923

# CONGENITAL CYSTS AND FISTULÆ OF THE NECK

A REVIEW OF 42 THYROGLOSSAL CYSTS AND FISTULÆ

BY PERCY KLINGENSTEIN, M D

AND

RALPH COLP, M D

OF NEW YORK, N Y

FROM THE SURGICAL SERVICE OF DR A S MOSCOWITZ MT SINAI HOSPITAL NEW YORK CITY

CONGENITAL cysts and fistulæ occurring in the cervical region have always excited interest. Their intricate and elaborate embryology and diverse pathological histology have aroused much speculation. A thorough knowledge of their anatomical relationships is of great importance in securing a complete extirpation which alone insures a cure. Recently renewed interest in this subject has been manifested, and many excellent papers have appeared, notably those of Thompson,<sup>1</sup> Christopher,<sup>2</sup> Sistrunk,<sup>3</sup> Bertwistle and Frazer,<sup>4</sup> and Bailey.<sup>5</sup> However, there still seems to be considerable confusion as to the origin of the embryological rests occasioning these congenital abnormalities. Much which Kostanecki and Milecki,<sup>6</sup> His,<sup>7</sup> Hammar,<sup>8</sup> and other embryologists have stated still remains unchallenged, but many of their interpretations and deductions have been justly questioned by the more recent investigations and excellent reconstructions of Wenglowski.<sup>9</sup>

It has been the custom of most surgeons to classify arbitrarily those cervical abnormalities occurring in the midline of the neck as originating from the remnants of the thyroglossal tract, while those which appear on the lateral aspect, as arising from the branchiogenetic system, with the possible exception of a small group which are indexed as hygromata.

But no proper classification of those anomalies can be made until their fundamental relationships to the structures from which they arise have been duly clarified. There are certain salient features and basal concepts which are of prime importance in making a proper diagnosis, for upon this will depend the plan and extent of the surgical procedure. Using the excellent paper of Wenglowski<sup>9</sup> as a guide, the various congenital cervical cysts and fistulæ, admitted to the surgical wards of the Mount Sinai Hospital, New York, 1913-1924, have been reviewed in the hope that a closer scrutiny of the embryology, pathology, and clinical features might place the diagnosis and treatment on a more rational basis.

The embryology of the lower jaw and neck region will be briefly summarized because it plays such an important role in the diagnosis, and in the surgical approach to these congenital abnormalities.

In the human embryo of 26 mm the first two branchial arches are quite clearly developed, the former bounding the primitive mouth, the latter placed just above the heart. Three or four other arches are developed subsequently, separated by the same number of branchial grooves. The ultimate fate of the

gill arches is well known, the first give origin to the side portion of the upper lip, the upper jaw, the lower jaw, and the body of the tongue. The second forms the body of the hyoid bone, its lateral attachments, and those muscles and ligaments which are attached to the styloid process, in addition to the anterior part of the root of the tongue and the palatoglossal arch. The third develops the greater horns of the hyoid, the posterior part of the root of the tongue, the palatopharyngeal arch and its muscles. The fourth, fifth, and sixth arches take their part in the development of the soft parts in the region of the horns of the hyoid. The branchial grooves which are found between these arches are dependent upon the growth of the latter. The mesial ends of the gill arches and furrows run anteriorly and orally, while the pharyngeal arches and pouches run below and aborally. From this it is apparent that the floor of the branchial depressions and the corresponding pharyngeal pouches run in different directions and lie upon one another only in one small area and even here there is a very definite partition separating these two structures. This is an important point, for it immediately becomes evident that the gill furrows are never open and can never communicate with the pharynx. The disappearance of the branchial furrows which occurs at the end of the second month is brought about by two forces: first by the ingrowth of mesenchymal tissue, and second, by the rapid growth of the branchial arches which approximate each other more and more, thus narrowing the furrows which finally disappear. And, with the disappearance of these furrows, the cervical sinus which His<sup>7</sup> incorrectly held responsible for the development of the thymus, and as coming from the second arch, also vanishes by the amalgamation of the under surface of the third arch with the projection of the lateral cervical fold. This is so complete that microscopic examination of sections of older embryos discloses the cervical sinus or its rests as vesicles of stratified epithelium embedded in mesenchymal tissue. It should also be remembered that some of the strands of epithelial tissue lying free in the mesenchyme undoubtedly become pinched off from the gill furrows, because the arches and the grooves are both covered with stratified epithelium. The pharyngeal pouches, too, are covered with stratified epithelium, but the third and fourth from which the thymus and thyroid arise, may be covered with islands of ciliated epithelium. From this short description the entire branchiogenetic system and its possible rests are limited, and must be limited to an area bounded above by the lower jaw, and below by the hyoid with its processes, and any congenital anomaly occurring below this boundary cannot possibly be considered as branchial in origin. In addition the branchial grooves remain for such a short time and are filled out so rapidly that it is difficult to conceive a perforation from the gill cleft beyond the second month.

So cysts and sinuses occurring along the mesial border of the sternomastoid muscle, ranging from the hyoid bone to the suprasternal notch must be accounted for in some other way, and the reconstructions of Wenglowski<sup>9</sup> make it fairly evident that these vestigial remains are intimately connected with the development of the thymicopharyngeal duct. The anlage of the

thymus is first noted in a 6.5 mm embryo as a small outgrowth from the third pharyngeal pouch, and while it unquestionably comes into contact with the epithelium of the cervical sinus, it is not a part of it. At first the thymic canal is horizontal, running from the lateral pharyngeal wall between the third and fourth arches, but it soon bends at right angles, crosses mesially and anteriorly and then runs downward, lying lateral to the upper part of the thyroid gland, its lower thickened end gradually sinking beneath the lateral thyroid anlage. The lower end of the thymic canal which is quite thick and without a lumen is lined with stratified, pavement epithelium, and here and there with ciliated cells. In a 16 mm embryo the lower end appears as a fully developed gland, and this finally sinks into the superior mediastinum anterior to the great vessels. As this occurs, the upper portion of the canal begins to retrogress. The direction of both thymic canals is essentially the same, running from the palatopharyngeal area sharply across the space between the ear and the angle of the jaw hence mesially and ventrally along the dorsolateral boundary of the thyroid and the mesial border of the sternomastoid muscle to the sternum below where both canals almost meet in the substance of the thymus. In an embryo, varying in age from two to three months, it is unusual to find thymic rests in the region of the pharynx, but these are quite common dorsal to the lateral lobes of the thyroid and especially below. Their structure is fairly typical, a centre of varying diameter, lined with ciliated or stratified epithelium, the nearer the rest is to the pharynx the more is ciliated epithelium apt to be present, and the nearer the rest is to the sternum, the more is stratified epithelium likely to be present. It is fairly common to have both in combination. Beyond the lining epithelium there is a heavy layer of epithelial cells and epithelioid cells resembling lymphoid cells. While these may exist in embryos from three to four months, they may remain latent throughout life, their fate being quite similar to those rests of the median thyroid anlage.

The development of the thyroid gland is not very complicated. In an embryo of 2.6 mm the median anlage of the thyroid is present as a small depression of mouth epithelium whose direction is anterior and in front of the heart and aortic region. Later this cylindrical epithelium grows into the depths as a firm hard strand of tissue without a lumen, then the lower part of the anlage begins to grow rapidly into two segments, a right and a left while the upper part eventually disappears, or may remain as a permanent strand, occasionally giving origin to the lingual thyroid. At the end of the fourth and beginning of the fifth week the simple process of the development of the middle lobe of the thyroid is complicated by the development of the hyoid bone, and since this structure bears such an important relationship to the radical cure of some thyroglossal fistulæ, the details of the development will be discussed later.

At the end of the second month the origin of the median anlage of the thyroid is a blind opening, the foramen cæcum covered with stratified epithelium, with an occasional ciliated cell. The lingual duct which develops about

this time is not a rest of the tractus thyroglossus, but rather a canal of mouth epithelium. In the third month the lingual canal has definite side branches, and these are lined with stratified and ciliated cells. In the fourth month it is branched so definitely that individual sprouts may change into isolated cysts which may later become pathologic. These cysts may also derive their epithelial building blocks from another source, namely, from those portions of the mouth epithelium which have mechanically been pulled down by the rapid downgrowth of the median thyroid anlage into the underlying mesenchymal tissue. Very often about these mucous cysts of the tongue small isolated areas of thyroid tissue may be present. These cysts occur, as a rule, at the root of the tongue or about the hyoid, less frequently near the foramen cæcum, more rarely near the isthmus of the thyroid.

The hyoid bone makes its appearance at about the fourth week in the region of the second arch, lying behind the thyroglossal tract, which, if it remains, may be bound to the periosteum of the hyoid on its inner aspect. For the next few weeks, in spite of this relationship, the thyroglossal tract lies in a more or less straight line. But as the body of the hyoid now grows behind and above, and at the same time in front and below, the tractus thyroglossus undergoes many complicated and important changes, dependent upon the further development of the hyoid bone.

The front and lower part of the hyoid presses the thyroglossal tract anteriorly and bends it, and in this way the tract is divided into two parts, the higher portion lying anterior to the hyoid and the lower portion going from its under end. At the beginning of the third month the hyoid changes materially, the anterior surface becomes convex, and the posterior concave, with the result that the lower strand is pushed more posteriorly. The hyoid is bent now almost at right angles and may give evidence of thyroglossal remains in three places—on the upper anterior surface, on the lower anterior surface, and on the posterior surface. In other embryos and in cadavers it is rather rare to find thyroid rests on either the upper or lower anterior surface, because these two areas of the hyoid exert the greatest pressure on the thyroglossal tract, usually causing its obliteration, while the rests on the posterior surface are more apt to remain undisturbed. Thyroid rests in the neighborhood of the hyoid bone are often found in adult and children cadavers and these may occur simultaneously with cysts of the tongue.

The lateral lobes of the thyroid are developed from the fourth pharyngeal pouches as wide pockets lined with stratified epithelium. These gradually sink deeper and become more anterior, finally blending with the median lobe as the original canal disappears. Remains of thyroid tissue may be found between the lateral pharyngeal wall and the thyroid cartilages, but the lateral thyroid canal usually disappears completely and rarely gives rise to any rests. More often portions of thyroid tissue may be pulled off the thyroid itself, and these particles lead to abnormally located thyroids dorsal to the œsophagus or between it and the trachea.

The difference between lateral and median fistule as far as their his-



tology is concerned, is quite a marked one. While the median fistulæ are built from epithelial rests derived indirectly from the median thyroid anlage and never possess an actual lumen, the lateral cervical fistulæ are derived from the remains of the thymic canal itself either in part or entirely. The presence of lymphoid tissue in appreciable amounts is another proof of their thymic origin. While the median anlage of the thyroid leaves behind the foramen cæcum, it never forms a complete median fistula, while the thymic anlage may form a complete lateral fistula. Lateral fistulæ and cysts are lined, as a rule, with stratified epithelium with endothelial characteristics—without hair, papillæ, sweat or sebaceous glands. Occasionally lying between the epithelium one may find ciliated cells, the ciliated epithelium being of the same variety as in the median fistulæ. However, the presence of epidermoid tumor or fistula with all its characteristics occurring in the lateral region of the neck, does not speak against its origin as a lateral cervical cyst or fistula, for the thymic canal as it rounds the corner previously described may take with it epidermal epithelium from two sources. The cervical sinus, which itself may form a primary cyst very similar to a dermoid may give some cells to the thymic canal, but there is still another way in which epidermal tissue may take part in the development of the thymus. It is perfectly possible for the deeper layers of epithelium from the third furrow to climb into the thymic anlage. This epithelium may keep its characteristics and not only aid in building Hassel's corpuscles, but also invest the thymic canal with structures of epidermoid character. This classification is thoroughly satisfactory in elucidating the histopathology of those cysts and fistulæ in which epidermal and endodermal tissues manifest themselves.

*Incidence*—There were in all forty-two cases of thyroglossal cysts and fistulæ. These we have divided into thyroglossal cysts of which there were thirteen, thyroglossal fistulæ, twenty, a combination of cysts and fistula, nine. During this ten-year interval a summary of the record shows that in all, sixteen cases have been classified as branchiogenetic cysts or fistulæ. In view of the somewhat meagre operative notes in some of these latter cases, it seems hardly justifiable to record these cases as of branchial origin, while in others, the operative findings supply ample proof that the diagnosis under which the patient was finally discharged from the hospital was untenable in the light of more recent embryological research. For this reason no detailed summary of this group of cases has been deemed advisable.

*Age*—In this series, cases occurred from the first to the sixth decades, and were grouped as follows: from the first to the tenth year, twenty-one, from the eleventh to the twentieth year, ten, from the twenty-first to the thirtieth, seven, from the thirty-first to the fortieth, two, from the forty-first to the fiftieth, one, and from the fifty-first to the sixtieth, one. In five cases the lesion was present at birth, in two a cyst presented, in three a fistula was noted. In two cases symptoms were noted during the first year of life. The oldest age at which the lesion was first discovered in this series was thirty-five and thirty-nine years of age, respectively.

## CONGENITAL CYSTS AND FISTULÆ OF THE NECK

*Sex*—It has been variously stated that this group of congenital affections was more common in females, corresponding to the greater incidence of thyroid disease of adult life, but this has not been borne out in this series. There were thirty-one males as opposed to only eleven females.

*Location*—Thyroglossal cysts and fistulæ may occur anywhere along the course of the thyroglossal tract, *viz.*, from the foramen cæcum to the body of the thyroid gland. For purposes of description these locations have been tabulated as follows:

- 1 Beneath the foramen cæcum
- 2 In the floor of the mouth protruding beneath the chin
- 3 Suprahypoid
- 4 Subhypoid
- 5 On the thyroid cartilage or membrane
- 6 At the level of the cricoid
- 7 In the suprasternal notch

The first three of these situations have been found extremely rare, in this series no cases have been observed here. The great rarity of the occurrence of thyroglossal cysts and fistulæ in this location must make one scrutinize very closely those cases which have crept into the literature under this heading, as possibly being dermoid cysts of the tongue,<sup>10</sup> ranulæ, or cysts having their inception in the lingual duct and not, as supposed, originating in the anlage of the thyroglossal tract. One case presented itself in the supra-hypoid region, and seven in the prehypoid region. In the presence of a cyst of any considerable size, it is sometimes extremely difficult to determine its exact location in relation to the thyroid cartilage and thyrohyoid membrane, for very frequently the swelling will overlap both structures, but in spite of this fact, we have classified twenty cases as thyrohyoid and three as cricoid. Three, also, presented themselves in the suprasternal notch. It has been almost universally taught that thyroglossal cysts and fistulæ present exactly in the median line of the neck, somewhere along the course of the thyroglossal tract. It is important to bear in mind that this need not necessarily be the case. In six cases of this series the cyst or fistula was definitely placed either to the right or left of the median line. Just recently one of us had occasion to excise a cystic swelling on the right side of the neck at the level of the thyroid cartilage. Its position was so far lateral to the median line that a diagnosis of thyroglossal cyst was barely entertained. In spite of this fact, a prolongation of the cystic mass was found to run to the under surface of the hyoid bone exactly in the median line, and the pathological report of the excised cyst wall and tract was reported back "Thyroglossal cyst." It is well to bear in mind, however, that although the opening of the fistula or cyst may be eccentrically placed, the tract itself is almost invariably found in a median position. Whether previous operative interference or the accommodation of the tumor to the various muscle and fascial planes accounts for its shift from a previously medial to a lateral position is merely conjectural and is simply offered as an explanation for the unusual find in some cases.

In those cases in which careful operative notes were appended to the records, it was found that the tract apparently split the hyoid bone in seven cases, in three cases it was found to run in front of the hyoid bone. No mention is made of any case in which it was clearly discernible that the tract ran behind the hyoid. In thirteen cases it was specifically stated that there was no connection between the tract and the hyoid bone, but any one who has operated a number of these cases will undoubtedly concur in the observation that when the tract reaches the region of the hyoid it becomes greatly thinned

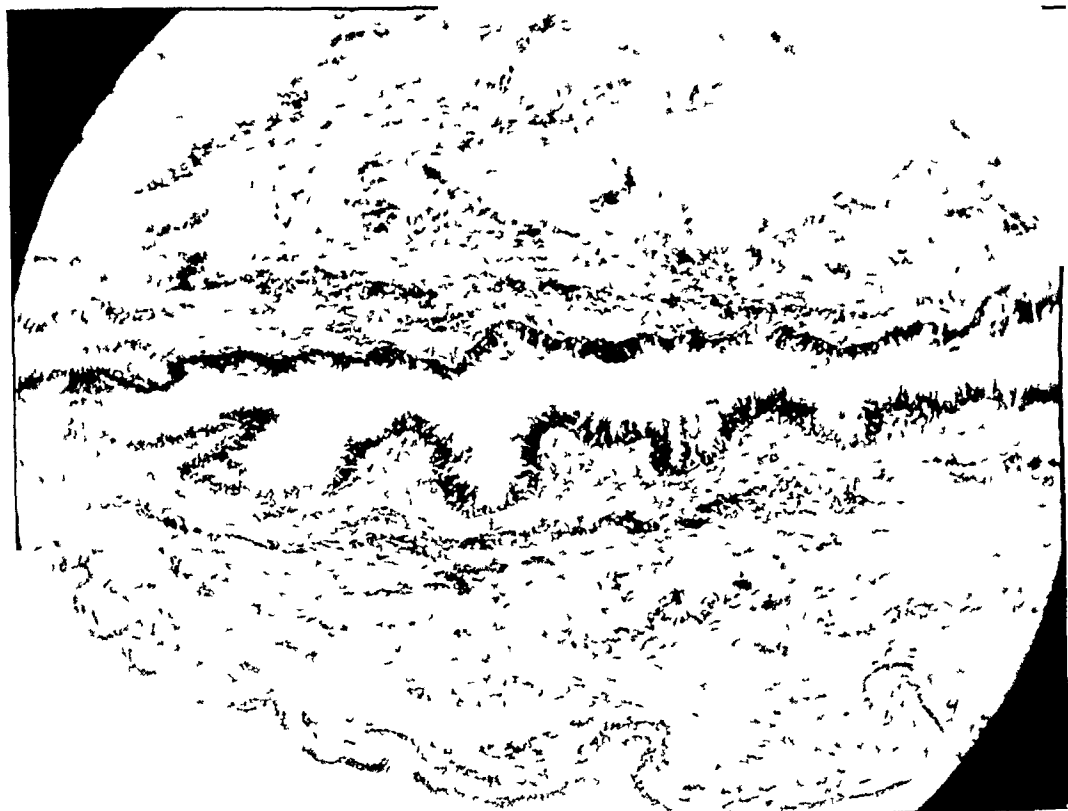


FIG. 1.—Photomicrograph showing general outline of a thyroglossal tract lined with stratified columnar epithelium.

and attenuated, at times almost indistinguishable from the surrounding fascial structures, so that to insure a complete removal not only the tract but the surrounding tissues in the mid-portion of the hyoid must be excised *in toto* to affect a radical cure. In the light of this fact, a statement that a thyroglossal tract preserves no connection with the hyoid bone must be guarded. This point will again be alluded to in discussing operative procedure. Perhaps a more general utilization of ante-operative injection of the sinus with a medium opaque to the X-ray as sodium bromide, would permit us to discover more accurately the relationship of the sinus to the hyoid bone with which it is usually so intimately connected. In six cases, the tract was traced upwards between the geniohyoid and the geniohyoglossus muscles where it was found to terminate at the foramen cæcum.

*Pathology*—In not all cases were the excised specimens submitted to the

## CONGENITAL CYSTS AND FISTULÆ OF THE NECK

laboratory for pathological examination. In two cases the material was reported as thyroglossal fistula or cyst, in six cases as fibrous tissue lined with epithelium. The epithelium was usually of a low cylindrical or columnar type, at times of a stratified columnar variety (Figs 1 and 2). In two cases no epithelial lining was discernible. It is supposed that in cases in which no epithelium is found upon microscopic examination, in the presence of clinical evidence supporting a diagnosis of a thyroglossal cyst or fistula, the long continued suppuration may destroy the epithelial lining (Fig 3). In two cases

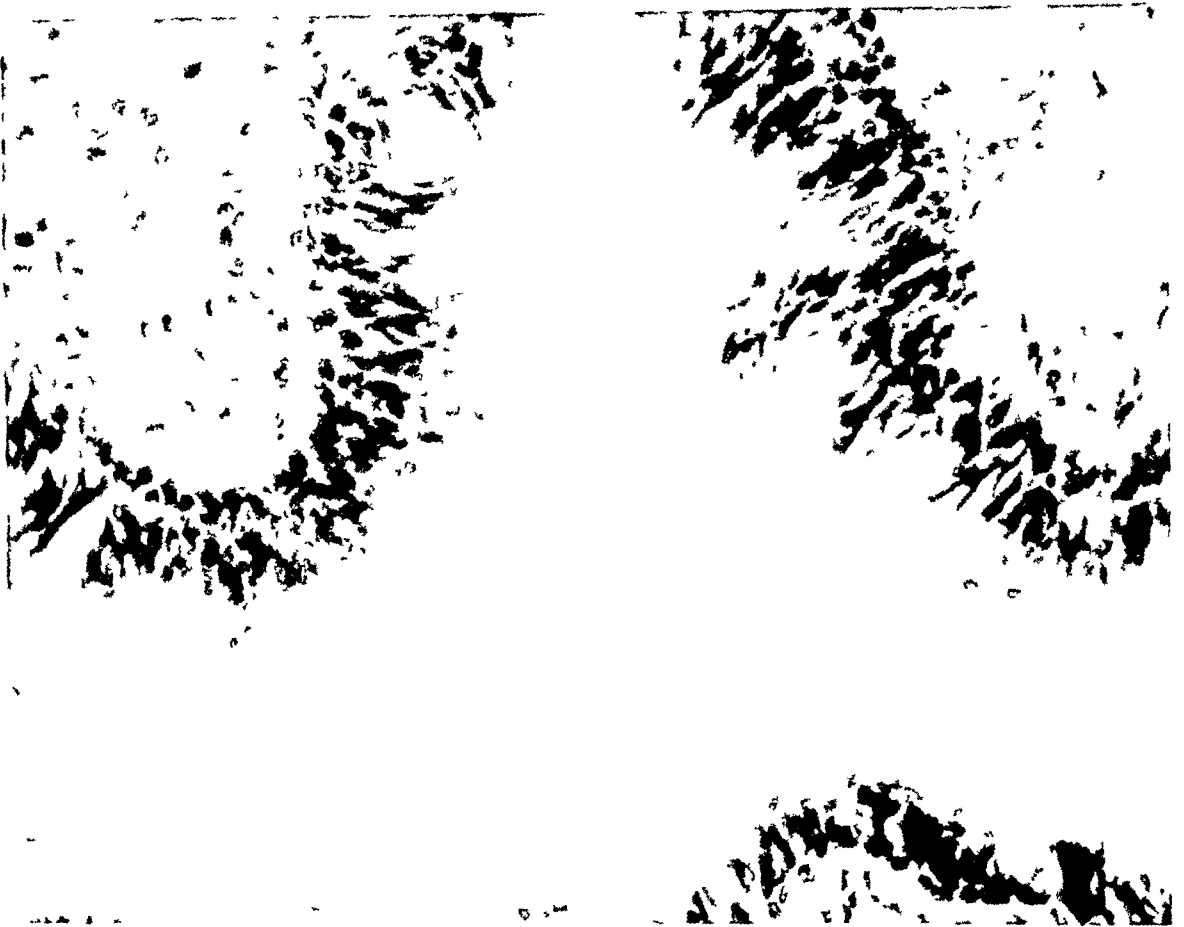


FIG. 2.—High-powered photomicrograph of a portion of the lining epithelium of Fig. 1.

large masses of lymphoid tissue surrounded the fistulous tract. In view of this finding it is barely possible that this represented remains of the thymico-pharyngeal duct. Mention of this will again be made in discussing pathogenesis. In two cases definite islets of thyroid tissue were found. It has been said that the presence of thyroid tissue along the course of the thyroglossal tract stands in inverse relationship to the normal development of the thyroid gland. In both these we find no mention made of the size of the thyroid gland or any evidence pointing to endocrine dysfunction.

*Pathogenesis*.—Thyroglossal cysts and fistulæ usually make their first appearance in infancy and childhood, in this series twenty-one occurred before the second decade of life. To what can we adduce this high percentage? In discussing "Pathology" we noted the fact that in some cases lymphoid tissue made up the bulk of the tract wall, in others, the epithelium was destroyed as though by an inflammatory process, while in some evidences of inflammation

were denoted by an infiltration of the tract by polymorphonuclear leucocytes or by round cell infiltration. The intimate relationship between the mouth epithelium and the original anlage of the thyroglossal tract makes it plausible that the same inflammatory processes to which the former is susceptible, particularly in childhood, accounts in some cases, at least, for a like susceptibility. With the onset of a tonsillitis or pharyngitis, to which the young are so prone, a similar reaction on the part of the lymphoid tissue in the thyroglossal tract would account for the pathogenesis in some cases. There were three cases in



FIG. 3 —High-powered photomicrograph showing a thyroglossal sinus lined with granulation tissue

which a history of upper respiratory infection antedated the development of the cyst. Metastatic infection of the thyroglossal tract may account for others.

The production of thyroglossal fistulæ, as opposed to cysts, is usually the result of rupture of the latter. This is borne out by the great paucity of congenital fistulæ in contradistinction to congenital cysts which are much more common. Suppuration in cysts, either spontaneous or by incision, play a part in the production of these fistulæ. Probably the most common cause is surgical intervention. No less than eighteen patients were operated upon before entering the hospital, with a fistula as the direct result of operative interference. This point will be further discussed under treatment.

*Symptomatology*—It is noteworthy how few subjective symptoms the presence of this lesion produces. Pain is usually absent—in only three cases was there definite pain, and this only in association with an inflammatory proc-

ess which the cyst was undergoing and which probably brought the patient to the hospital for treatment. A tumor was present in fifteen, whereas a sinus occurred in twenty-nine. In the cases in which a discharge was a prominent symptom, it was mucus in six, purulent or muco-purulent in ten, in thirteen, the character of the discharge was not mentioned. In none was it profuse. In only one was it more profuse on swallowing. In six cases the discharge was intermittent.

*Physical Findings*—These are usually fairly characteristic depending upon whether we are dealing with a cyst, fistula, or a combination of both. In the former we usually find a small, round, tense cystic mass, varying in size from a pea to a walnut, over which the skin is usually movable, except in the presence of an inflammatory process, in which case the skin may become adherent. Fluctuation is not always elicited on account of tension within the cyst wall. The location of the lesion has already been discussed. In the presence of a fistula a small, firm mass of tissue may be felt by careful palpation, running subcutaneously from the region of the fistula to the hyoid bone, where it is lost as it emerges in the substance of the latter to make an acute angle with that bone from where it penetrates the tongue musculature.

*Diagnosis*—The diagnosis is at once simple and difficult. In the absence of infection, a medially situated tense cystic mass or fistula should at once suggest the diagnosis. In the presence of an inflammatory reaction, the lesion must be differentiated from an enlarged, chronically or acutely inflamed submental or prehyoid lymph-node. The presence of a dermoid cyst in the median line of the neck, while offering difficulties in diagnosis, may be correctly differentiated by aspiration.<sup>11</sup> Ectopic thyroid glandular tissue must be borne in mind in differentiating any mass in the neck. Tumors or masses in the floor of the mouth, particularly lingual dermoids or submental cysts (remnants of the lingual duct), or deep-seated ranulæ must be ruled out. In certain cases the opening of a lateral cervical fistula is close to the median line, particularly in those having their exit just above the clavicle, but in these cases it will be noted that the opening is situated just to the outer border of the sternocleidomastoid muscle.

*Treatment*—Simple incision of a non-suppurating or suppurating thyroglossal cyst invariably leads to the formation and persistence of a fistula, which must be dealt with radically at a later date. No operative treatment that is not based upon the known relationship of the thyroglossal tract to the hyoid bone, tongue musculature, and foramen cæcum, as outlined in the portion of this article dealing with the embryology of these structures, can hope to be radical. Prior to the application of these principles, recurrences of the fistule were the rule rather than the exception. Numerous references in the literature bear evidence to this fact. While surgeons undoubtedly had appreciated this fact, it was not until 1919 when Beer<sup>11</sup> and Sistrunk<sup>12</sup> independently published an operative technic for the cure of these fistule, that the treatment was put on a rational basis. Their operative procedure takes the above-mentioned points into consideration and will be outlined briefly.

A transverse incision (all neck incisions in so far as is possible should be transverse), circumscribing the sinus, is made, dividing the skin and platysma muscle. The skin flaps are mobilized and the tract, which usually lies superficially at this point, is dissected free from the surrounding prethyroid muscles, and is traced upwards to the hyoid bone. At this point the tract becomes thin and attenuated and no attempt is made to detach it from the hyoid. The periosteum over the hyoid is divided, and the mid-portion of the hyoid resected subperiosteally and freed. The tract is then further enucleated by coring through the tissues between the hyoid and the foramen cæcum. It is important to bear in mind, in this connection, the angle that the tract makes with the hyoid in ending at the foramen cæcum. This will be found to be an angle of 45 degrees. With this in mind, those portions of the median raphe of the mylohyoid, the geniohyoid, and geniohyoglossus muscles, surrounding the lingual portion of the tract are removed *in toto* up to and including the foramen cæcum. If the dissection has been started low down in the neck, a supplementary transverse incision at the level of the hyoid may become necessary. The periosteum of the hyoid is brought together with interrupted chromic sutures. The lateral portions of the divided tongue musculature are likewise united. A small rubber dam or tube is introduced for drainage purposes. This can usually be safely removed at the end of forty-eight hours. The skin is approximated with silk. If any appreciable defect be made in the mucous membrane of the tongue, this also should be united with catgut.

## BIBLIOGRAPHY

- <sup>1</sup> Thompson, J. J. Surg, Gyn and Obst, 1920, vol. XXVI, p. 31
- <sup>2</sup> Christopher, F. *Idem* 1924, vol. XXXIII, p. 329
- <sup>3</sup> Sistrunk, W. E. ANNALS OF SURGERY, 1920, vol. LVII, p. 121
- <sup>4</sup> Bertwistle, A. P., and Frazer, J. E. Brit Journ Surg, 1925, vol. XII, p. 561  
Bailey, H. *Idem* vol. XII, p. 579
- <sup>5</sup> Kostanecki and Milecki. Arch f Path Anat 1890, vol. CXXI, p. 55
- <sup>6</sup> His, W. Archiv fur Anat u Phys Anat Abth, 1886
- <sup>7</sup> Hammar, J. A. Beit Z Path Anat u / Allg Path, Jena 1904, vol. XXXVI, p. 506
- <sup>8</sup> Wenglowski, R. Arch f Klin Chir, 1912, vol. XCIII, p. 151
- <sup>9</sup> Colp, R. Surg, Gyn and Obst, 1925, vol. VI, p. 183
- <sup>10</sup> Beer, E. ANNALS OF SURGERY, 1920, vol. LVII, p. 218

# COMPRESSION OF THE SPINAL CORD BY TUMOR\*

By WILLIAM JASON MIXTER, M D

OF BOSTON, MASS

ASSISTANT VISITING SURGEON, MASSACHUSETTS GENERAL HOSPITAL

ANY tumor causing symptoms of spinal cord disturbance must except in rare instances cause this disturbance by compression, whether the tumor is within or without the spinal cord. The exception being metastatic malignant disease within the cord itself causing destruction of cord tissue without compression. This condition is a rare one and I have seen it once only. If there is compression of the spinal cord there must also be a more or less complete blocking of the cerebrospinal space at the tumor level, either by a fusiform swelling of the cord, if the tumor lie within it, by the tumor itself if the tumor lie between cord and dura or by an indentation of the dura if the tumor be outside.

The recent advances in the diagnosis of cord tumor are directed in the main to a recognition of this encroachment on the cerebrospinal space and the resulting changes in the cerebrospinal fluid. There has been, and still is, a good deal of difference of opinion as to the value of this type of diagnostic procedure. This difference of opinion naturally adds to the interest of the subject and the matter will not be settled until a large number of observations have been made in early or doubtful cases. I am convinced that any procedure which will permit us to make a diagnosis of cord compression in the preparalytic stage will be of great value. It seems practically certain that careful investigation of the cerebrospinal space will many times give us the data for such a diagnosis in the absence of convincing neurological evidence.

I have attempted to group the cases of spinal cord lesion, in which tumor was thought to be the cause, which have come under my care, and the resulting figures are perhaps of some interest. In addition to the eighty-five proven cases I have included sixteen in which a negative exploratory laminectomy was performed, but have omitted all cases in which the suspicion of the presence of cord compression was not sufficient to warrant exploration.

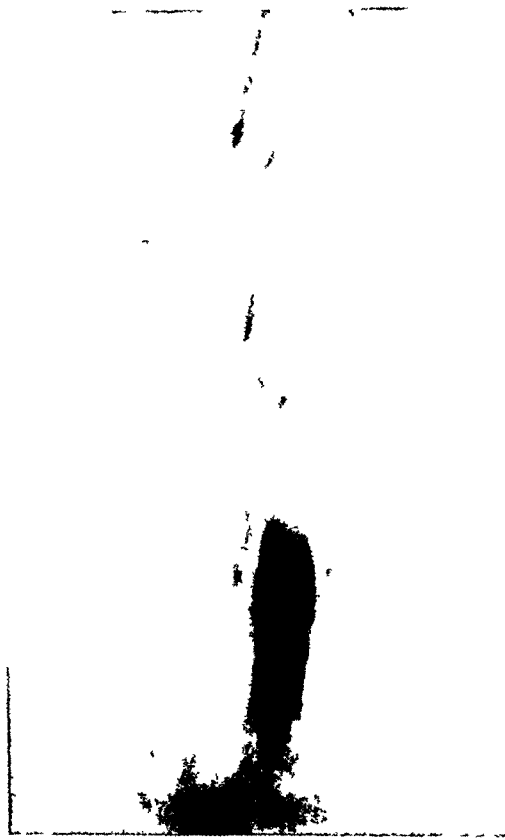


FIG. 1.—Lipiodol in the lumbar sac

\* Read before the American Surgical Association, May 6, 1925



As will be seen, there were nineteen cases of intramedullary tumor and the end results were almost uniformly bad. There were thirty-five cases in which the tumor arose from structures outside the cord but inside the bones of the vertebral column. Of these, twenty-six were cured or definitely and permanently improved.

Tumors of the vertebral column, metastatic or primary, were twenty-eight in number and are a study in themselves. I shall not attempt to discuss them or the five cases of intraspinal tuberculous abscess which were classed as tumor suspects. There were sixteen in which no lesion was found at operation, which is far too large a number. Ninety-eight laminectomies were performed with five operative deaths.

A further analysis of the group of extramedullary intra-

spinal tumors show that in this class were practically all of the successful cases. Of the thirty-five, ten were meningioma and eight neurofibroma, the rest were scattering. Twelve are symptomless, fourteen were definitely improved, many of them working. Only three have died of tumor, two of these being malignant leiomyoma metastatic from the uterus. There were two operative deaths. The average lapse of time between onset of the first symptom and operation was twenty-seven months. Earlier recognition of these cases would make for better results, as irreparable damage is almost invariably done to the spinal cord in cases where compression has been of long duration.

I am convinced that the future will bring a great change and that cord tumors will be recognized and treated at a much earlier date. Careful study of the cerebrospinal fluid in cord tumor cases is of the utmost importance and new refinements of technic are being added to the accuracy of this procedure. For a complete discussion of the subject, reference may be made to the work of Dr. J. B. Ayer.<sup>1</sup> Lumbar puncture should be performed in all cases of

FIG. 2 —Carp above a neurofibroma



FIG. 3 —Same as Fig. 2 lateral view

## COMPRESSION OF THE SPINAL CORD BY TUMOR

suspected cord tumor and if there is any doubt as to the presence or absence of block, combined puncture of the cisterna magna and the lumbar space is indicated. Lumbar puncture or combined puncture in a case of this sort, or indeed in almost any case, should include careful manometric readings and study of the chemistry and cytology of the fluid as described by Ayer. Simple withdrawal of, and a more or less haphazard study of the fluid, is not sufficient. At first we were unwilling to accept these cerebrospinal fluid findings, and I therefore operated on a number of patients in spite of negative cerebrospinal fluid findings. A negative exploration almost invariably resulted. Many of these patients, either by progress of the disease or autopsy, have been shown to be sufferers from multiple sclerosis, combined system disease or other degenerative lesion of the cord itself. I am now refusing to operate on such patients. Conversely I am operating where the neurological evidence is inconclusive but where the cerebrospinal fluid shows evidence of block.

In cases in this series in which examination of the cerebrospinal fluid was made, lumbar puncture was conclusive in about 80 per cent and doubtful in 20 per cent. In the 20 per cent combined puncture was necessary to eliminate this element of doubt.

The value of cerebrospinal fluid examination in suspected tumor is no longer a matter of debate; it has been conclusively proven. The only question is: How often will lumbar puncture alone be sufficient? Recent refinements in the technic of lumbar puncture as suggested by Stookey<sup>2</sup> may lessen the need of combined puncture, but I am sure there will always be a considerable number of cases in which it will be necessary, probably in the neighborhood of 20 per cent. We have only had two cases in which operation has failed to reveal tumor where cerebrospinal fluid examination suggested compression and it may well be that this was due to failure on my part to



FIG. 4.—Intramedullary glioma. Note the small masses of lipiodol squeezing by the fusiform enlargement of the cord.

find the tumor. Only once have I found tumor where the cerebrospinal fluid findings were negative and that was some four years ago when the technic of examination was less complete than at present.

The most recent, and in many ways the most striking, advance in diagnosis of these lesions, is the use of a substance opaque to the X-ray (lipiodol) in the spinal subarachnoid space as advocated by Sicaud.<sup>4,5,6</sup> After various experiments we have limited its use to cases where block is positive and always inject it above the tumor. If a positive localization can be made without the

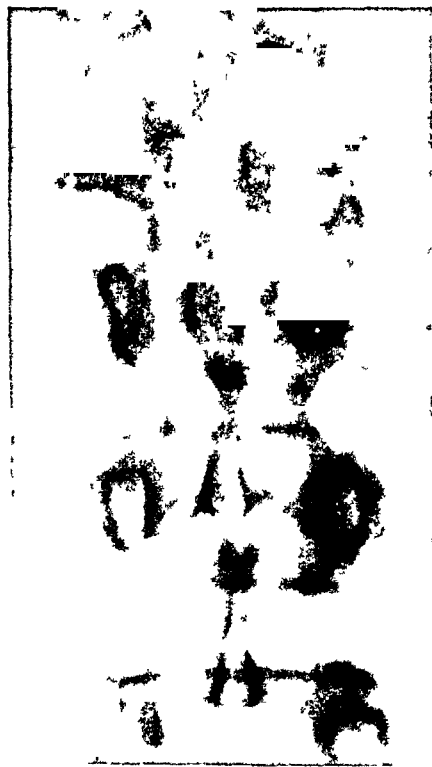


FIG. 5.—Neurofibroma of cauda equina (case of Miss A. G.). Note the absence of formation of a typical cap; the tumor being buried in the cauda equina.

help of lipiodol I prefer not to use this drug, as it remains indefinitely in the cerebrospinal space. No permanent ill effects have been reported from its use, though it is temporarily irritating as shown by rise in temperature, headache, and increased cell count in the cerebrospinal fluid.

From one to two cc. of the drug is injected into the spinal canal usually by puncture of the cisterna magna and with the patient in the vertical position. Its slow passage through the spinal canal is followed either by the fluoroscope or by repeated plates. During its descent the masses of lipiodol are more or less sausage-shaped and have rounded cells. When it finally comes to rest in the lower end of the lumbar sac in the absence of obstruction, it is usually in the form of an inverted cone. There may be false arrest of the lipiodol in the canal and if such is the case the sausage-shaped masses persist. In true arrest caused by some obstruction in the canal the lipiodol may be seen as a cap over the tumor or as narrow streaks alongside of the obstruction.

In order to emphasize the possible value of these new diagnostic methods, one case may be cited.

Miss A. G. Referred by Dr. A. N. Broughton. This patient had had severe pain running from the lower spine down the right leg for some months. The pain was spasmodic in character and markedly increased by motion. She was unable to urinate while lying in bed, but aside from this had no symptoms which would suggest paralysis. Examination revealed a uterine fibroid and pain on any attempt to move the lower spine or the right leg. There were no paralysis, reflex changes or sensory disturbance whatever. Lumbar puncture performed by Dr. H. C. Solomon, between the twelfth dorsal and first lumbar and between the fourth and fifth lumbar vertebrae, revealed a block between these two points.

Lipiodol injected through the upper needle moved only as far as the second lumbar vertebra. Operation revealed a neurofibroma within the cauda equina so buried in the cauda that no cap could form. This growth was completely removed and now six months later she is well.

## COMPRESSION OF THE SPINAL CORD BY TUMOR

Laminectomy has been so standardized by the work of Doctor Frazier, Doctor Cushing and Doctor Elsberg that there is little more to be said, but there are a few points in technic that I would like to suggest. I have found that exposure is adequate if the dissection is carried down on one side of the spinous processes. These structures are undercut, as shown in the diagram and reflected with the ligaments and the muscles of the other side. In closing such a wound sutures in the muscles are unnecessary. A careful approximation of the fascia to the interspinous ligament is usually sufficient.

After the laminae have been removed, inspection will often reveal a local thinning of the epidural fat. Such a condition strongly suggests the presence of tumor. If no tumor is found on opening the dura at the level suspected, the behavior of the cerebrospinal fluid should be noted. Normally or above tumor the fluid will show a very considerable pulse wave, the pulsation being transmitted downward from the cranial cavity. If there be a tumor present blocking the spinal canal, this wave will be almost absent below the tumor. If the anesthetist be directed to compress the jugulars for a moment, the cerebrospinal fluid will rise rapidly in the wound in the normal case, whereas the presence of a tumor at a higher level will prevent such a rise. Careful removal of the dural base of tumors, involving that membrane, should be performed where possible and any defect closed with a free transplant to

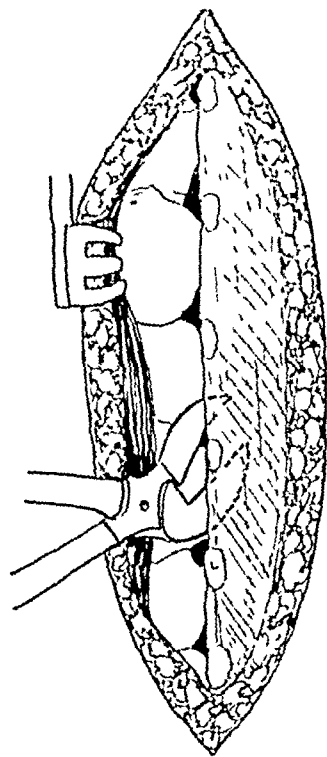


FIG. 6 —Diagram showing preservation of spinous processes

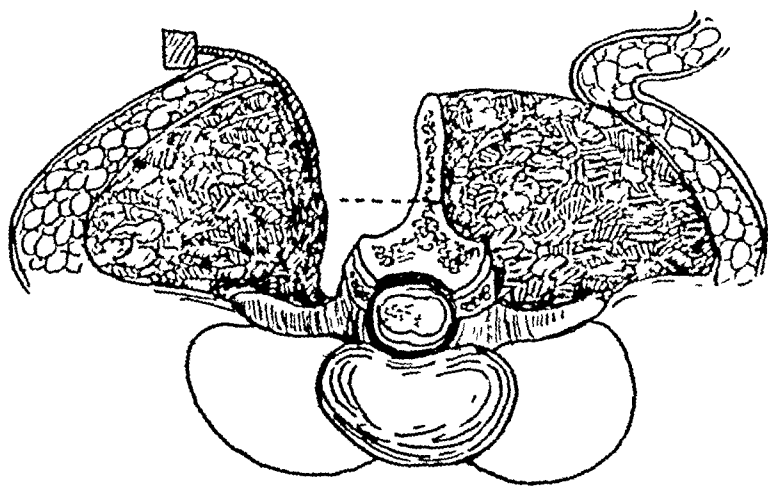


FIG. 7 —Diagram showing preservation of spinous processes (Cross-section)

prevent the leakage of cerebrospinal fluid and the resulting danger of meningitis.

In conclusion I would like to emphasize the fact that a very considerable percentage of tumors causing cord compression are easily and completely removable, and that if removed early enough return of

function will be complete. That early operation depends on an early diagnosis and that to this end careful and complete study of the spinal fluid is as important as is laboratory work in the study of the gastro-intestinal case.

The use of lipiodol in the spinal canal is indicated in a considerable percentage of cord tumor cases, as it is safe and accurate

These newer procedures must in no case be expected to supercede the older methods of examination. A careful and complete neurological examination should always be performed

TABLE I

Disease	Total	Improved	Not Improved	Improved Died later	Died
Tumors of the cord	19	2	2	12	3
Tumors of structures between cord and spine	35	26	1	3	5
Tumors of vertebra	28	2	3	4	19
Spinal tuberculosis	5	2	2	—	1
No lesions found	16	—	8	—	6*
Laminectomies	98	Operative deaths 5			

\* (Two cases (untraced))

TABLE II

	Total	No Disability	Impvd	Not impvd	Impvd died later of tumor	Operative deaths
Meningioma	10	4	4	1	1	—
Neurofibroma	8	6	1	1	—	—
Cholesteatomatous cyst	3	—	3	—	—	—
Fibrosarcoma of cauda equina	3	—	2	—	—	1
Adamantinoma of cauda equina	2	—	1	—	—	1
Cyst of dura	1	—	1	—	—	—
Enchondroma	3	1	1	1	—	—
Malignant leiomyoma	2	—	—	—	2	—
Chronic inflammation (extradural)	2	1	—	1	—	—
Fibrosarcoma of dura	1	—	1	—	—	—
	—	—	—	—	—	—
	35	12	14	4	3	2

## BIBLIOGRAPHY

- <sup>1</sup> Ayer, J. B. Spinal Subarachnoid Block as Determined by Combined Cistern and Lumbar Puncture, with Reference to Early Diagnosis of Cord Tumor. *Arch Neurol and Psychiat*, vol. vii, p. 38, 1922
- <sup>2</sup> Stookey, Byron. Presented at the Meeting of the Assn for Research in Nervous and Mental Diseases. Dec., 1924
- <sup>3</sup> Sicard, J. A., and Foestier, J. Methode radiographique d'exploration de la cavite epidurale par le lipiodol, *Rev neurol*, vol. xxviii, p. 1264, 1921, Methode general d'exploration radiologique par l'huile iodée (lipiodol), *Bull et mem Soc de chir de Paris*, vol. xlv, p. 463, 1922
- <sup>4</sup> Laplane, L. Le radio-diagnostic des affections intra-rachidiennes par le lipiodol sous-arachnoïdien. La forme pseudopottique des tumeurs intra-rachidiennes, Paris, Amedee Legrand, 1924
- <sup>5</sup> Mixter, W. J. The Use of Lipiodol in Tumor of the Spinal Cord. *Arch Neurol and Psychiat*, vol. xix, p. 35 July, 1925

# ORIGIN AND DEVELOPMENT OF THE BLOOD SUPPLY OF WHOLE-THICKNESS SKIN GRAFTS

AN EXPERIMENTAL STUDY

BY JOHN STAIGE DAVIS, M D

AND

HERBERT F TRAUT, M D

ROCKEFELLER FELLOW IN PLASTIC SURGERY

OF BALTIMORE, MD

FROM THE SURGICAL DEPARTMENT OF THE JOHNS HOPKINS UNIVERSITY AND HOSPITAL

## INTRODUCTION

THERE has been considerable difference of opinion as to the origin and development of the blood supply of whole-thickness grafts, and the object of this study is to determine these processes as exactly as possible. In the past, most of the observations concerning the circulation of skin-grafts have been made from the microscopic study of bits of skin excised at varying intervals after transplantation. In order to determine accurately the various phases of the development of the circulation, injections of the newly formed vessels must be made. As this is obviously impossible in the human, it has been necessary to resort to animal experimentation.

In this study, three points have been under consideration. First, whether an anastomosis is formed between the vessels of the graft and those of the grafted area, second, whether or not the capillaries of the grafted area grow into the graft by extending into the old vessels of the graft, third, whether the capillary up-growth from the grafted area penetrates the connective tissue of the graft and thus establishes a blood supply. Much theorization concerning these processes is found in the literature of the past thirty-five years, but little evidence has been brought forward to support them.

GARRI, who was the first to do careful histological work on skin grafts, interested himself in the reestablishment of the blood supply and observed that most of the vessels of the graft degenerate so that but few persist. Sixty-two hours was the earliest that he was able to demonstrate new vessels in the graft with what he thought was circulating blood in them. He felt that the new vessels often grew up inside the old ones and that a portion of the new vessels degenerated while the remainder persisted and continued to grow and form the permanent circulation of the graft.

JUGRANFF, an extremely careful observer, found capillaries in the fibrin-net beneath the graft on the third day, and he believed that these vessels grew upward from the host and eventually accomplished an anastomosis with the old vessels of the graft. How this anastomosis was accomplished he did not seem to understand fully.

GOEDMAN, in his work published in 1894, described for the first time, the process known as plasmatic circulation ("plasmatische circulation"). He felt that the graft was nourished during the first days following transplantation by an influx of lymph and leucocytes and that the graft was caused to heal by its inherent "lebensenergie." He also stated that all of the vessels of the graft degenerated and were eventually replaced by an upward growth of vessels from the host.

ENDREX whose work has been the most exhaustive and the most carefully executed of any done in this field drew his observations both from clinical material removed from

patients after operation and from animal experimentation. He stated that the blood-vessels of the graft degenerated almost completely and were replaced by new ones. This, he thought, was accomplished in two ways: first by the survival of islands of endothelium in the old vessels which after proliferation re-formed the blood channels and anastomosed with those of the host, and second that new capillaries grow upward from the host into the graft. He did not state the mechanism of this upward growth.

BRAUN, believed that the circulation of the graft was established, at least in part, by using the old vessels of the graft. He stated that after three and one-half years in one of his cases these old vessels were evidently in use. All of Braun's material was removed from patients after transplantation.

MARCHAND in his classic monograph on wound healing, used the work of Enderlen as a basis to which he added some of his own ideas. He found that the vessels of the graft commenced to degenerate on the first day. Very early, however, new well-formed red blood cells were seen in the vessels and also these vessels could be injected with an injection mass. He felt that the vessels stood in some patent relation to those of the host and formed the, so-called "plasmatic canal." How this relation came about he could not answer but he thought that perhaps the vessels grew up from below or that perhaps they were regenerated in a very short time from surviving endothelial elements remaining in the old vessels of the graft.

NEUBER, in his recent monograph on "The Transplantation of Tissues," has added very little to the work of those who have already labored in this field but rather summarizes it in the light of his experience. He states that within a few hours after the graft has been applied leucocytes of the fibrin layer migrate into its interstices and are to be found in the lumina of its empty blood-vessels. Most of the blood-vessels in the transplant degenerate. By injection experiments he found that new vessels could be demonstrated in the cutis grafts on the third day. The newly built vessels arise by a budding of the capillaries in the fibrin layer and the buds not infrequently extend directly into the vessels of the graft.

Thus, it can be seen that there is wide divergence in the theories and observations of those who have sought to clarify this interesting phenomenon. All agree that there is a migration of leucocytes and an inflow of lymph into the graft. The cells are first seen in the lumina of the old vessels and later they invade the whole transplant. This has given rise to the theory that a plasmatic circulation is established very early, probably within a few hours after transplantation and that this circulation plays a role in nourishing the graft until such a time as the blood circulation can establish itself and take over this function. Another point on which there is unanimity of opinion is that the first new blood-vessels are found in the graft between forty-eight and sixty hours after transfer. However, several investigators have noted that well-formed and apparently living red blood-cells were found in the old vessels of the graft at an earlier time, one observer finding them as early as the thirty-sixth hour. That there is a very active degenerative process going on in the graft commencing almost immediately after transfer also seems established and counteracting this, there is active proliferation of the various elements of the graft, which beginning slowly gains impetus, striking a balance with the degenerative phase at about the sixth or eighth day and from that time on, dominating the picture until at the end of from fourteen to twenty days the graft has regained a normal appearance with perhaps some increase in the connective-tissue elements.

## BLOOD SUPPLY OF WHOLE-THICKNESS SKIN GRAFTS

The tearing down and building up process in the grafted tissue varies with the status of the circulation of the transplant. In other words it depends on the degree in which the graft is in contact with the nourishing fluids of the body. In this paper, we attempt to analyze this process and to demonstrate the factors controlling it, together with the mode whereby the new circulation is established.

### METHOD

The dog has been used in this study as its abdominal wall provides an area sufficient for a series of grafts, so that it is possible to have grafts varying in age from a few hours to many days, all under identical conditions. The whole-thickness graft was chosen because it presents all the problems of the other types of skin grafts and in addition has greater bulk, which, from the point of view of the establishment of the blood supply and of the nourishment of the graft, accentuates each phase of the process.

Under ether anesthesia, the operative procedure was carried out as follows. The skin was carefully shaved and then cleaned with green soap followed successively by ether, alcohol and five per cent picric acid. The grafts were all of the same size measuring three centimetres in length by one and one-half centimetres in width, and were in the shape of an ellipse, thus making the closure of the skin possible without undue tension. The graft was carefully measured and outlined with five per cent brilliant green and was then excised, the whole thickness of the skin being taken together with the subcutaneous fat. The fat was then carefully removed, either with a pair of curved scissors or with a sharp scalpel. The raw surface of the transplant was then placed directly upon muscle tissue and was fixed with silk sutures in such a way that it measured the same in length and breadth as it did before excision. By this procedure, the normal tension of the skin was imitated. The wound edges were then closed over the graft. Thus the transplant was immobilized on a muscular bed which is ideally rich in blood supply and at the same time was protected from the possibility of trauma and drying out. The operation was repeated at intervals such that at the end of an experiment we had in each animal, grafts varying in age from one to forty days, the intervals between the last ten grafts being of twenty-four hours. The animal was sacrificed at the end of the completed experiment and the whole body was then carefully injected with India ink, through the heart. The areas containing the transplants were then excised, and fixed in formalin and alcohol. Half of each graft with its muscular bed was cleared by the Spaltcholtz method and the other half was cut into serial sections. By this means, it was possible to trace the vessels for considerable distances in the cleared specimens and to determine their exact relation to the graft. The serial sections were used to check the findings thus made and to determine the exact position of the new vessels in relation to the old ones in the graft. These sections were also utilized to determine the cellular content of the vessels, old and new, and to gauge the degree of degeneration and repair in the graft. A series of eight experiments was carried through.

Despite the most careful technique a graft would occasionally become infected and would slough. Needless to say, when this occurred the area was discarded from the experiment. However, the method worked so well that not only could the original grafts be recovered at the end of the experiment, but often the epithelium had spread out from the margins to cover the adjacent tissues and in the older grafts a sac or tube was obtained which was lined on the inside with healthy epithelium. The most important point



in the technic is the fact that the grafts were buried. This made immobilization and even pressure possible, provided the best conditions for growth and obviated the possibility of trauma and dying out, which conditions are difficult to obtain in surface grafts on animals.

*Development of the Blood Supply*—In common with others, we have found that immediately after the graft is placed upon its new bed a fibrin network is formed, which seals it in place, and later by contraction pulls the two raw surfaces into closer approximation. During the next twenty-four hours, two very different processes are at work. That which is most quickly in evidence is the migration of round cells and wandering cells from the graft bed into the fibrin network and thence into the graft itself. These cells find their way into the old vessels of the graft in large numbers, as well as into the connective stroma, and eventually force their way into all parts of the corium. They apparently do not go beyond the corium into the epidermis. Indeed, the picture of these cells rapidly and effectively making their way about is so striking that it has been noted by all who have studied the circulation of skin-grafts. Goldman, who was the first to describe this process, thought that it must have a function in causing the survival of the graft by nourishing it during the interim when it was without blood supply and gave the phenomenon the name of "plasmatische circulation." That he was right in his supposition gains weight as we have observed that in those grafts, in which the vessels are collapsed so that these cells and the accompanying lymph cannot enter them quickly, there is a much greater degree of degeneration and sometimes complete sloughing of the transplant. In Ollier-Thiersch grafts, this plasmatic circulation probably does not play such an important rôle, because in this relatively thin tissue, the body fluids with their cellular content can more easily penetrate and nourish, and this is also true in small deep grafts as on account of their small size a blood supply sufficient to cause survival is much more quickly established.

At the same time, that is, during the first twenty-four hours, the other process at work is the development of highly vascular granulation tissue which replaces the fibrin network between the graft and the underlying tissues. This occurs with remarkable celerity, so that the graft rests upon a connective tissue basis which is rich in newly formed capillaries transporting circulating blood between eighteen and twenty-four hours after transplantation.

During this period, we note that degenerative processes are also going on in the transplant. The epidermis suffers most and in nearly all the grafts there is a complete slough of the epithelial layers distal to the Malpighian layer, and even in this stratum there is always a very considerable thinning of the cells. In the corium, the connective-tissue elements undergo marked destruction, including that of the vessels. The endothelium of the vessels degenerates and except in an occasional area becomes completely necrotic. The hair follicles and sebaceous glands show little degeneration and consequently slight repair. They are the most viable elements of the skin and

## BLOOD SUPPLY OF WHOLE-THICKNESS SKIN GRAFTS

in a successful graft show no alteration whatever. In a sloughing graft, they are the last elements to disappear. This process continues until the seventh or eighth day, when apparently a balance is reached and proliferation of the surviving elements is in excess of the degeneration. That this turning point is dependent upon and determined by the establishment of an adequate blood supply cannot be doubted, for in specimen after specimen vascularization reaching to all parts of the graft is first found at this time.

The sections and cleared specimens showed us that the establishment of the blood supply takes place in three ways. First, Figs 1 and 2, the earliest connections between the vessels of the granulation tissue base and those of the graft are in the form of anastomoses between the small capillaries of the graft and those of the base. Often a small capillary in the base will establish a connection with a slightly larger vessel

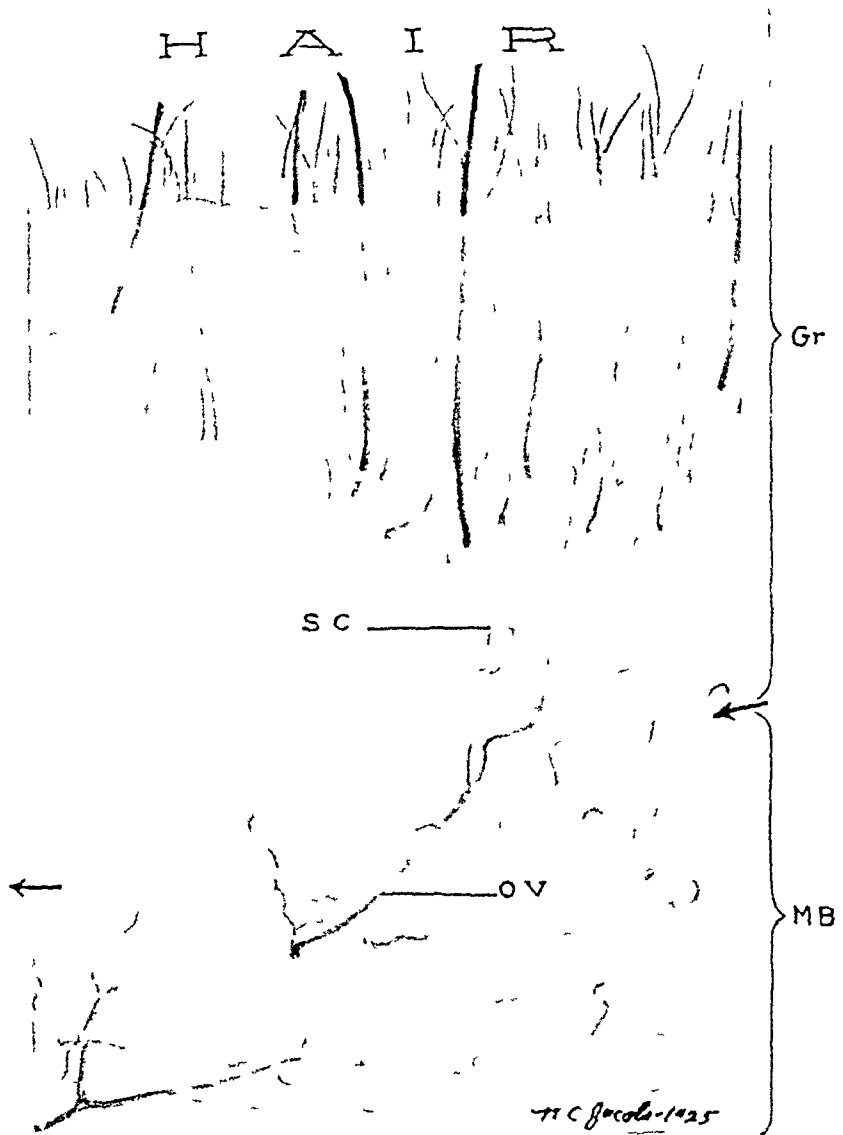


FIG. 1.—Drawing of an injected and cleared specimen removed three days after operation. Gr, whole thickness skin graft, MB, tissue on which graft was placed, OV, blood supply of the host tissue, SC, surviving capillaries. The arrows indicate the lower margin of the graft. The capillaries extending well up toward the surface of the skin are well shown and are seen to be quite extensive. These capillaries are injected at this early date because they have established anastomoses with the vessels of the host tissues.

in the graft and this is seen sufficiently often to convince us that these are really anastomoses and not outgrowths of the capillary. The first blood supply to the graft is established in this way, taking place as early as twenty-two hours after transplantation and becoming more and more common as time goes on. Injections of such vessels, extending from the base of the corium up into the papillae and back again were obtained at the end of twenty-four hours and we consider this as additional evidence that these are the result of actual anastomoses and are not outgrowths of capillaries from below.

The second means by which the blood supply is established is much slower

and takes place by the upward growth of the capillaries of the granulation tissue developing their loops and penetrating the connective tissue of the corium. Probably most of the vascularization is accomplished in this way. One can see many loops in a single microscopic field, all of the same height and with approximately the same number of branches. As the older specimens are studied, these invading loops, more and more nearly approach

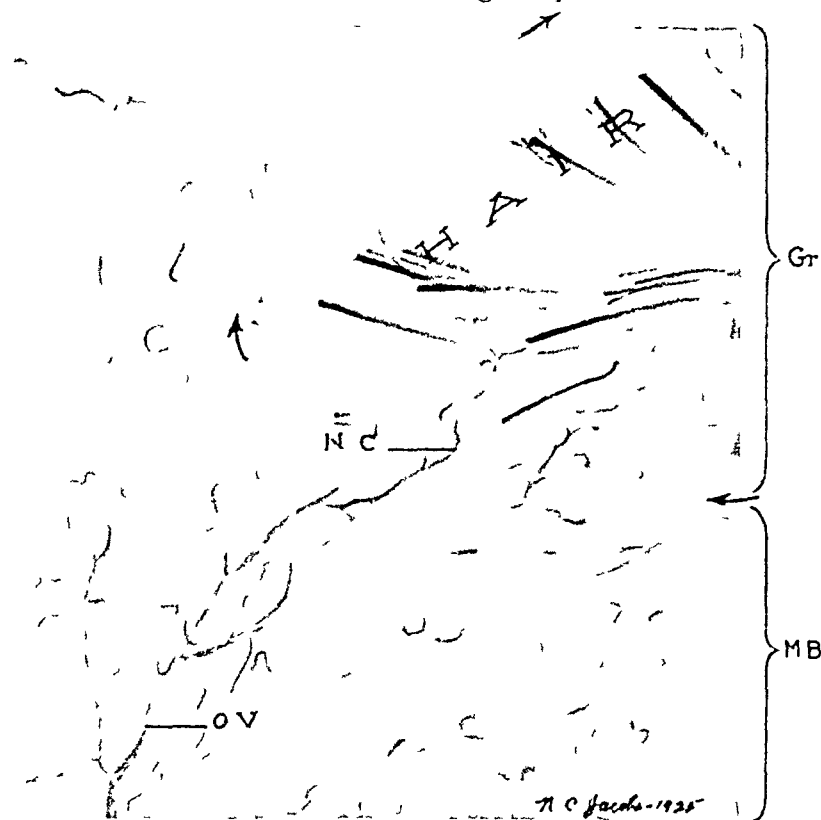


FIG. 2.—This drawing shows one end of a whole thickness graft with the superficial tissues closed over it. The specimen was removed five days after operation injected and cleared by the Spaltcholtz method. The arrows indicate the margin of the graft. Gr whole thickness graft, MB host tissue. O V vessel of the host tissue, N C capillary which has anastomosed with the underlying vessel. The injected capillary in this specimen reaches upward to the tip of a papilla of the corium & c to the Malpighian layer. This is another example of the circulation of the graft being established by anastomosis

the Malpighian layer, and actually reach it about the twelfth day. In number, these capillaries far exceed those of the normal skin (Fig. 3) and are more numerous than those found in the older grafts. So we conclude that a great number of them subsequently degenerate and disappear.

A third means by which the circulation is established is as follows: A sprouting capillary in the granulation tissue at the base

of the graft finds its way upward, inside one of the old vessels of the graft, (Fig. 4). This forms a path of slight resistance so that the capillary grows very rapidly as compared to those which have to make their way through the connective-tissue stroma. Apparently, here and there, where there are patches of surviving endothelium in the wall of the old vessel, an anastomosis occurs and one of the smaller branches of the vessel is opened to the capillary, and thus an early circulation is established relatively high up in the corium. Cross-sections of these old vessels with the capillaries inside them are seen in the microscopic slides, but we have never found one of these large vessels completely injected, although the capillary inside it is seen injected together with some small branch of the old vessel. This, we think, is a relatively unimportant mode of vascularization, because it is only occasionally seen.

## CONCLUSIONS

Although these observations have been made from experiments on animals we are convinced that the development of the circulation of whole thickness skin grafts in the human organism is practically the same, and that certain conclusions may be safely drawn

From the foregoing, we conclude that there are two stages in the process of actual vasculariza-

tion of the graft. These are preceded by what has been called the stage of plasmatic circulation, which probably bears an important rôle in the survival of the whole thickness graft.

The first stage of vascularization is supplied by those vessels which form early anastomoses with small vessels of approximately the same calibre in graft and host. The earliest that this was noted was about twenty-two hours after transplantation, and this continued to occur up to about seventy-two hours. The second stage and the most important one, as it establishes a more voluminous blood supply which eventually forms the per-

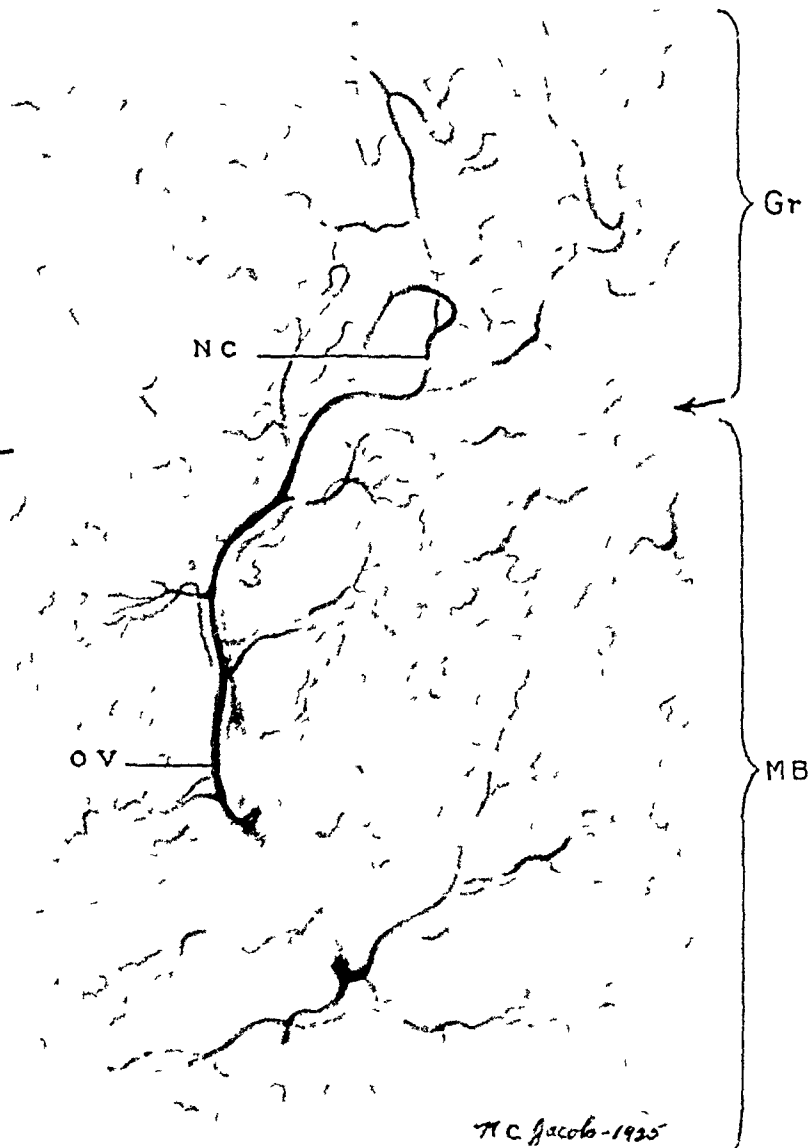


FIG. 3.—This specimen was removed on the forty-first day following operation. It was treated in a manner similar to those depicted in Figs. 1 and 2. Gr, graft; MB, muscular host tissue; OV, vessel of the host tissue; NC, new capillaries. This drawing demonstrates another mode of establishing the circulation in skin grafts. The capillary network of the graft is the result of upward growth from the host tissues. As will be seen the plexus is extremely dense. Later this becomes greatly modified, many of the vessels disappearing.

manent vessels of the graft begins on the fourth and fifth day and has completely penetrated the graft by the twelfth day. At this time the various elements of the graft are actively regenerating, especially is this true of the connective tissue of the corium which is richly supplied with new blood-vessels. The regeneration of the Malpighian layers and those of the epidermis become active later and in some specimens are of normal thickness and appearance only in the older grafts that is in from twenty-four to forty days.

All the larger vessels of the graft degenerate and are absorbed. Branches of these vessels may survive by becoming anastomotic with an invading capillary, but if this does not occur, they also disappear. As stated before, some of the smaller vessels anastomose with the invading capillaries and thus survive, but the bulk of the circulation in the surviving skin grafts is derived from the up-growth of capillaries from the host tissue upon which it rests. Since this is true, the problem in causing whole-thickness skin transplants to survive, centres about the period beginning at transplantation and ending at about the eighth day, when these upward growing capillaries have invaded the

graft to such an extent that they furnish a circulation which makes the survival of the graft secure.

Since we know the processes, at least in part, which are at work during this period of latency, perhaps some deductions may be made applying to operative technic, which would aid the anabolic proc-

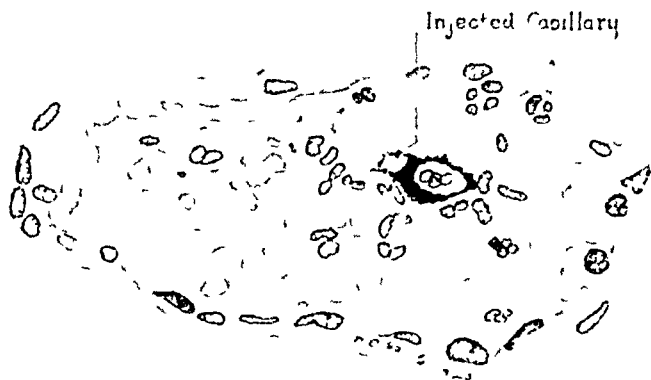


FIG. 4—A drawing of a microscopic section showing a vessel in cross-section about midway between the base of the corium and the Malpighian layer. The specimen was removed twenty four hours after operation. Inside the vessel are many red blood cells and an injected capillary also with red blood cells inside it. This demonstrates a third mode whereby the circulation is established in skin grafts.

esses and reduce to a minimum those of a catabolic nature. In general, anything which tends to close or seal off the cut ends of the vessels of the transplant, will inhibit the inflow of lymph and migration of the cells into it. It has been pointed out that those grafts which show the least infiltration with monocytic cells also suffer the greatest degree of degeneration, and this induces us to believe that these cells and the lymph which accompanies them, do perform a nutritive function. The cells find their way into the graft most quickly by means of the patent vessels, so that any technic which closes them, is probably disadvantageous. Clinically, it is a common practice to remove the fat from the whole-thickness graft before transplanting it, by clipping it off with a pair of curved scissors. This removes the fat in a very satisfactory way, but it also pinches a great many of the vessels so that they remain occluded, and thus hamper the cell and lymph migration materially. This is particularly true of the thin-walled veins. The examination, under the binocular microscope of a graft prepared in this way, readily convinces one that this is true, whereas, if the fat be removed with a sharp scalpel all the vessels remain patent and provide the best conditions for the establishment of the plasmatic circulation.

The amount of tension under which the graft is placed when it is sutured into its new bed, is of the greatest importance for the same reason. If the

## BLOOD SUPPLY OF WHOLE-THICKNESS SKIN GRAFTS

tension is less than that which is normally found in the skin, the contracting tissue will effectually occlude the smaller vessels and most of the larger ones. It is a better fault to overstretch, than to understretch a graft. However, the ideal is to so carefully measure the dimension and shape of the defect, that the transplanted skin may be placed under approximately the same tension that it bore before it was removed from its original site.

### SUMMARY

1 The blood supply to whole-thickness skin grafts is established in three ways by anastomosis of small capillaries of about the same calibre, by the upward growth of capillaries inside the old vessels, and by the invasion of capillaries from the host tissues, the last being the slowest means as well as that supplying the permanent vessels.

2 The earliest that we have been able to demonstrate circulation in the graft is at the end of twenty-two hours.

3 Adequate circulation, which can determine the survival of the graft is not established until the eighth day.

4 The graft is nourished in the interim by two means—a plasmatic circulation, which is most important, and by the early anastomosis of small capillaries.

5. Any technic which tends to occlude the vessels of the graft is disadvantageous.

### BIBLIOGRAPHY

- Braun, W. Klinisch-histologische Untersuchungen über die Anheilung ungestielter Hautleppen. *Beiträge zur Klinischen Chirurgie*, vol. xxv, 1899, p. 238.
- Enderlen. Histologische Untersuchungen über die Einheilung von Pfropfungen. *Deutsche Zeitschrift für Chirurgie*, vol. xlv, 1897, p. 453.
- Galle. Ueber die histologischen Vorgänge bei der Anheilung der Thiersch'schen Transplantationen. *Beiträge zur klinischen Chirurgie*, vol. iv, 1889, p. 625.
- Goldmann. Ueber das Schicksal der nach dem Verfahren von Tiersch verpflanzten Hautstücken. *Beiträge zur klinischen Chirurgie*, vol. xi, 1894.
- Henle, A. Beiträge zur Lehre von der Transplantation ungestielter Hautleppen. *Beiträge zur klinischen Chirurgie*, vol. xxv, 1899.
- Hubscher. Beiträge zur Hautverpflanzung nach Tiersch. *Beiträge zur klinischen Chirurgie*, vol. iv, Part II, 1889.
- Lackento, A. Kurze Mitteilungen über Propfung der Haut auf Granulationsflächen. *Berliner klinische Wochenschrift*, vol. viii, 1871.
- Jugengel. Verhandlungen der physikalisch-medicinischen Gesellschaft zu Würzburg, vol. iv, 1891.
- Kaig. Studien über transplantierte Haut. *Archiv für Anatomie und Entwicklungsgeschichte*, 1888.
- Krause. Ueber die transplantation grosser ungestielter Hautlappen. *Kongress der deutschen Gesellschaft für Chirurgie*, vol. xxii, 1893.
- Lever, E. Die freien Transplantationen. *Neue Deutsche Chirurgie*, vol. i, p. 188, 1919.
- Marchand. Wundheilung. *Deutsche Chirurgie*, vol. xvi, 1901, p. 407.
- Neuhof, H. *Transplantation of Tissues*. D. Appleton and Company, 1923.

# X-RAY AS A DIAGNOSTIC AID IN CASES OF HÆMANGIOMA

By LOUIS DUNN, M D

OF MINNAPOLIS, MINN

THE significance of phleboliths in tumors when demonstrated by X-ray is not generally appreciated by the profession, but is well known to the pathologist and the roentgenologist, the latter considering it a characteristic finding of hæmangioma. As illustrative of its usefulness, the following case

history is submitted

The case was that of a man, age forty-seven weighing 180 pounds, who presented a tumor of the left chest wall in the axillary line, on a level with the inferior scapular angle. His family history was negative except that his mother died from cancer of the intestines.

About the middle of February, 1925, after extreme exertion, he experienced a severe pain in the calf of the right leg. Two days later the calf of the left leg began to pain him. Within five days, pain developed in the right thigh posteriorly, which has continued to present time. General massage and bathing failed to give him relief but doubtless produced trauma-



FIG 1—Skiagraph of chest wall showing presence of tumor in the substance of which multiple phleboliths are discernible

matism of a quiescent hæmangioma. He developed a pain in his right shoulder while returning to his home on the 10th of March. Again a full body massage was given. It seemed to relieve somewhat the pain in his legs but he continued weak and he experienced night sweats with a very offensive odor. When seen later by me, he was weak with blood-pressure, 110 systolic. An enlargement was observed on his left chest wall. This was 14 cm perpendicular by 16 cm transversely. It was not very sensitive and was of the firmness of his muscles. He was under observation for one week, when the chest was X-rayed. The skiagraph (Fig 1) revealed the outline of a tumor mass in which multiple phleboliths were plainly discernible. The presence of these phleboliths caused the radiologist, Dr R G Allison, to suggest the diagnosis of hæmangioma for the tumor.

The patient submitted to the removal of this tumor April 14, 1925. Local anæsthesia was produced by infiltrating the chest wall for a space of 14 cm paralleling the spinal column and 6 cm from it including the intercostal nerves in this area. An L-shaped

## X-RAY AS A DIAGNOSTIC AID IN CASES OF HEMANGIOMA

incision following the infiltration from above downward then transversely forward to within 10 cm of the sternum was employed allowing the raising of a flap upward from the latissimus dorsi. The fibres of this muscle were separated, exposing a tumor mass, so large that a transverse section of the muscle was necessary in order to obtain sufficient space for its removal. The tumor was attached to and infiltrated the under surface of the serratus magnus muscle. The tumor was loosely attached to the underlying ribs and was readily separated. The inferior angle of the scapula with the serratus magnus to within 8 cm of the sternum was removed with the tumor. Hemorrhage was negligible.

*Discussion*—The diagnosis of hemangioma from the X-ray plate was so new to me and seemed so uncanny and improbable, that the operation was performed with the assumption that we were dealing with a sarcoma. The diagnosis by Doctor Allison was based upon the fact that phleboliths often occur in thrombosed blood-vessels. They are especially frequent in the pelvis. It is conceded that blood clots might readily become calcified in hemangioma elsewhere. A demonstration of multiple round calcified areas in certain tumors would therefore suggest the diagnosis of hemangioma. Ewing observes "that thrombosis and the formation of calcified phleboliths occur in dilated sinuses." McCallum says, "In all these angiomata, circulatory disturbances may occur. Infection may cause an inflammatory reaction in their substance, thrombosis of the blood channels is common and phleboliths may be found. It is not infrequent to find parts of them scarred and obliterated by such processes, with abundant pigmentation." The roentgenologist has frequently found them. Baetjer states, "The X-ray examination shows them (hemangioma) as large soft tissue swellings. Lying within the tumors are a series of round calcified bodies having concentric rings within them. The appearance is characteristic and when once observed can not be mistaken." The finding of round, multiple calcified areas in tumor masses of an uncertain nature justifies the diagnosis of hemangioma. It is with the purpose of calling attention to this diagnostic aid that this report is made.

The tumor formed a sheet of fat 3 cm thick, 14 cm long by 12 cm wide. Attached to the under surface of the serratus magnus and infiltrating this muscle and fat mass were numerous large and small blood-vessels, some being 1 cm in diameter. No capsule was present. The flat shape of the tumor is accounted for by its situation under the serratus magnus. Ewing says, "The growth of blood-vessels is markedly influenced by the element of mechanical pressure of the circulation." The shape of an angioma is frequently determined by pressure occasioned by its situation. The flat tumor in the case reported is accounted for by its having grown between the serratus muscle and the rigid chest wall. The situation of the tumor is unusual. The wealth of blood-vessel anastomosis about the inferior angle of the scapula offers a rich field for the growth of an angioma. The extensive and frequent movements of the scapula would supply the mechanical dilating factor to the blood spaces producing the growth of an angioma the walls of which have not the supporting structure of a normal blood-vessel.



The muscular pains previous to operation and the muscular weakness which developed in groups of muscles in his legs following the operation were attributed, by the neurologist, to a beginning multiple sclerosis. This had nothing to do with the growth of the hæmangioma which must have been of long standing, except that the massage which had been so vigorously applied produced a trauma resulting in a thrombosis and the subsequent formation of the phleboliths.

Dr R G Allison has seen at the University Hospital (Minn.), three cases of hæmangioma in which phleboliths were present. The hæmangioma had been present from birth and were situated on the hand, on the forearm and over the deltoid. The ages were, respectively, thirty months, four years and six years.

The conclusion one is justified in reaching is that age is not a factor in the development of phleboliths, but that the situation of the hæmangioma making it more liable to either traumatism or infection is the factor that invites thrombosis and later the deposit of calcium in the blood clot.

#### REFERENCES

<sup>1</sup> Ewing. Neoplastic Diseases, p 222, 1919

<sup>2</sup> McCallum. Text-book of Pathology, p 966, 1921

<sup>3</sup> Baetjer, Waters. Injuries and Diseases of Bones and Joints, p 277, 1921

# MYOSITIS OSSIFICANS CIRCUMSCRIPTA

A CLINICAL AND EXPERIMENTAL STUDY

By ADAM GRUCA, M D

OF LWOW, POLAND

ASSISTANT AT THE SURGICAL CLINIC OF THE JOHN CASIMIR UNIVERSITY  
DIRECTOR, PROF. DR. HENRY SCHRAMM

ALTHOUGH the appearance of parosteal bone within muscle following trauma is known for over two centuries (Fay), though the condition is not a very rare one, as the number of cases reported exceeds some hundreds, and its course, forms, its clinical picture and some points of etiology are minutely described, still many questions connected with it, as its place in pathology, its relation to injury and other diseases of movement apparatus, and above all, the question of its genesis, are not sufficiently explained. By experimental studies the questions could not be solved up to now. Clinical observations therefore are the only means of solving the problem, and any case that serves to reveal some new points should be reported. Therefore, I think it advisable to describe some cases which have occurred in the course of the last three years at the surgical Clinic of the John Casimir University of Lwow.

## REPORT OF CASES

CASE I.—A G., male, aged forty-six. Family history unimportant. Has never been seriously ill. In 1916, twice wounded on the left leg. During the last two years of war, at the Italian front, he was obliged to walk much through mountains. After each long march he felt pain in the anterior upper third of the right thigh. After some rest the pain disappeared. At various medical examinations nothing abnormal could be found in the ailing region.

On his return from the war, 1918, the trouble disappeared. He was quite well, working as a joiner until last year when the pain appeared again. Three months ago he noticed in the upper third of the right thigh an induration in the painful region. The extremity deviated outward and he began to limp. Two months ago he noticed in the painful region a swelling gradually increasing in size. There has never been a direct injury to the now painful region. The physical examination after his admission to the Clinic resulted as follows:

A strong man. Internal organs normal. The right leg in slight outward rotation, not shorter than the left. The right inguinal region below the anterior spine of the ilium and the upper third of the thigh at the anterior and lateral aspect diffusely swollen. The skin excepting a slight dilatation of veins unchanged. In the middle of the swelling was palpable a hard mass extending from below the spina ili anterior superior downward to the internal condyle of femur which ended at the level of the lower limit of the upper third of femur, movable unattached to the bone or skin, not especially tender. The mass was of bony consistency. Flexion of the thigh and inward rotation limited, abduction and extension normal. On the left calf two large soft scars not attached to the bone. Wassermann reaction negative.

The X-ray examination revealed just below the anterior superior iliac spine a shadow about 1 cm. in diameter about 15 cm. long well limited showing in its centre a lighter space like bone-marrow unattached to the femur (Fig. 1). (The hip-joint was unfortunately not included in the photographic plate.) Diagnosis *Myositis ossificans*.

Operation, March 1, 1924 An incision was made along over the mass The mass was then removed It was surrounded by a hard capsule of scar tissue, lying in the antero-lateral bundles of the quadriceps muscle, grown strongly together with them and attached by a strong fibrous tissue bundle to the spina ili anterior inferior At the upper end of the mass at the level of the hip-joint a cyst was opened, grown with the bony mass, filled with about two hundred ccm of thin bloody serous fluid The cyst communicated with the hip-joint cavity The hip-joint capsule, muscles, fascia and skin

were closed with sutures

During the next three days fever till 39 degrees and some spontaneous pain

March 9, from the upper end of the wound escaped some serum-like fluid

March 18, patient begins to walk, but feels discomfort at the region of the hip-joint March 25 discharged

He returned a month later complaining of tenderness at the hip-joint and inability to walk The Rontgen-ray examination showed destruction and deformation of the head of the right femur and acetabulum and a triangular



FIG 1 —Case I Bone plate in the quadriceps femoris muscle

lar exostosis at the anterior inferior iliac spine losing itself gradually in the soft parts without distinct limits Diagnosis Arthritis deformans coxae dextr

The bony mass removed was irregularly quadrangled, about 15 cm long, 1 cm in diameter, surrounded by a strong fibrous capsule The mass was thicker at the upper, than at the lower extremity

*Microscopical Examination* \*—Transverse section of the mass At one side of the periphery of the section, an island of well-preserved skeleton muscle was to be seen surrounded by fibrous connective tissue, some of them degenerated and atrophied In other parts fibrous connective tissue, partially hyaline changed, with only slight amount of nuclei and very few blood-vessels, containing here and there small plates of osteoid tissue, surrounded by osteoblasts The connective tissue near these bone islands appeared more loose and showed many nuclei, arranged concentrically along the osteoid plates so that

\*All microscopical pictures were interpreted by Dr H Schuster Pathologist of the University and all the microphotographs were furnished by Dr J Misinski Assistant of the Institute of the Descriptive Anatomy of the John Casimir University

their limits were not very sharp. It appeared as if the osteoid tissue originated directly from the connective one. The bony trabeculae were either homogeneous or there were in their centre distinct spaces filled with fat or loose connective tissue forming bone-marrow.

Near the described plates at the other side of the section one met with a large island of typical spongy bone tissue sharply limited from the neighborhood. This island had an oval outline, size 0.6 by 1 cm. The trabeculae of typical bone structure were surrounded by an abundance of osteoblasts. The bone-marrow contained, as above, abundant fatty or loose connective tissue, joining here and there the surrounding fibrous tissues. The last was seen in some places to extend between the bone trabeculae and become fat tissue. Cartilage traces were found in the middle of some bony plates. Nowhere were inflammatory symptoms apparent (Fig. 2).

CASE II—B. T., aged twenty-eight, a sportsman. Family history unimportant. Never experienced any serious illness. July, 1923, at a football match, a fellow player struck him heavily with his knee on the upper part of the right thigh. The blow was so severe that he fell down. After a while was able to continue the match to the end. On the same day the injured region became swollen and discolored considerably. The severe pain by touching and movement caused him to remain in bed for the next four days. He was treated by massage and bathing.

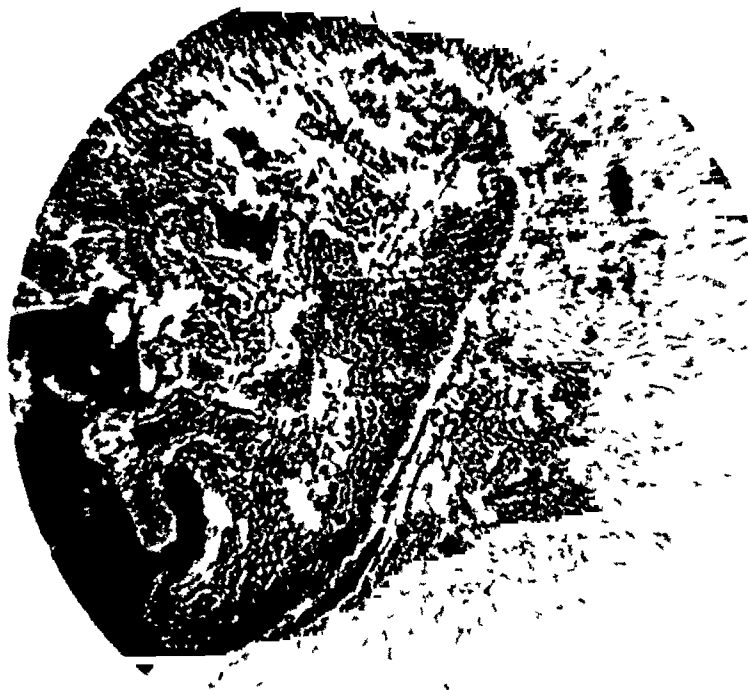


FIG. 2—Microphotograph of the plate removed in Case I. Transverse section (50 x 2).

On the sixth day he got up and went about. Six weeks after the accident, although the region was somewhat swollen, he played again and was hit once more but slightly on the same spot. The pain this time was so severe, that it was necessary to carry him home. He limped three days. Three months after the first injury the swelling had decreased slightly, only aching on movement. At the end of last year the discomfort had increased.

The X-ray examination made four weeks after the first trauma showed below the top of the right major trochanter a shadow about 7 cm. in length, 1½ cm. in diameter, irregularly limited of unequal power, parallel to the axis of the femur but separated from it by a narrow zone of light. The femur bone was unchanged.

Diagnosis. Myositis ossificans incipiens (Fig. 3).

Physical Findings, March 1925.—An athletic well-built man. General examination essentially negative excepting caries dentium.

At outer aspect of the right thigh about 7 cm. below the top of the trochanter a mass was palpable of bony consistency about 5 cm. long, thick as a finger, attached to the shaft, tender on pressure especially on the ends. Flexion at right hip-joint over 90 degrees possible. By maximal flexion the region of the anterior superior iliac spine is painful. At abduction a sharp pain below the trochanter major and at the hip-joint. Inability of crossing the right thigh over the left owing to pain.

Rontgen-ray examination About four fingers below the top of trochanter begins a shadow about 6 cm long, 1 cm in diameter, cigar-like, sharply pointed, attached to the femur with a pedicle, the shadow of which was brighter than of the rest of the mass On the upper margin of the acetabulum there is an exostosis about 2 cm long triangled, pointed outward and downward On the head of the femur itself, externally and internally, two small spots of bone atrophy (Fig 4)

CASE III—J K, aged thirty-four, a policeman, fell and struck his right knee four years ago Since that time walking somewhat painful

Rontgen-ray examination revealed at the right thigh anteriorly, about 1 cm above the patella, an oval shadow, 4 cm long 1 cm large, irregularly shaped, of unequal intensity, nearly 1 cm distant from the femur when the knee is flexed to 135 degrees Otherwise the knee-joint normal (Fig 5)† The mass was of bony consistency, tender on strong pressure, well limited, movable, attached to the posterior surface of the quadriceps tendon

Diagnosis Myositis ossificans of the quadriceps muscle Was not operated because of but little disability



FIG 3—Case II Four weeks old parosteal callus

CASE IV—M I, aged sixteen, a girl Parents and other members of her family well She was never seriously ill till four years ago, when she noticed a pain in the left hip-joint, without any trauma preceding The pain increased from time to time, being felt mostly in the evening

State, December 1, 1924—Girl of delicate stature, badly nourished Excepting a shortening of the percussion time over the top of both lungs, the internal examination revealed nothing abnormal The muscles of the left leg very atrophied The leg 9 cm shorter than the right, fixed in adduction, extension and inward rotation Movement of the hip-joint considerably limited abduction quite impossible Pressure on the trochanter painful

X-ray examination showed total destruction of the head of femur and of the acetabulum The last laterally and sagittally displaced On the inner side of the iliac bone in

†I am indebted to Doctor Lenartowski for placing the X-ray plates of Cases III and VIII at my disposal

the region corresponding to the bottom of acetabulum an abundant callus The left sacrospinous ligament ossified

Diagnosis *Luxatio coxae supracotyloidea pathologica* Ossificatio ligamenti sacrospinosi (Fig 6)

CASE V†—C R., male, aged sixty-five, butcher, 1922, was complaining for the last year of pain in both lower extremities and spastic contracture of the muscles of both thighs Not an habitual drinker Wassermann test negative The X-ray examination of the pelvis, vertebral column and both thighs negative

During the next year complete ankylosis of both hip-joints developed, also contractures in the knee-joints The pain increased in intensity and reached to the pelvic region Repeated

X-ray examination showed the joint cavity of both hip-joints disappeared, the heads of both femurs flat and grown together with the acetabulum The margins of acetabulum deformed and enlarged Ossification of both sacrospinous ligaments, especially of the left Roughening on the trochanter minor giving to it a fungous shape The margins of the fourth and fifth lumbar vertebrae uneven beak- and hook-like deformed (Figs 7 and 8)

Diagnosis  
Spondylitis ankylopoetica with ossification of the sacrospinous ligaments

CASE VI—S

K., eighteen years old, scholar No constitutional disease among the members of his family Has never been seriously ill, excepting measles ten years ago During last four years, while playing football, received several blows on both legs without any complication Thirty-four days ago (May 15, 1925) was struck by a thick iron tube on his left thigh The pain it caused was so trifling that he could walk till evening feeling no special discomfort The next day the contused region became swollen and discolored tender on pressure but not specially painful when he was walking The knee could be flexed only to about 135 degrees Within the five days the tenderness disappeared almost completely, only a circumscribed swelling remained The flexion of the knee returned also to normal limits After a week he played football again, feeling no discomfort Two days later, however, a severe pain on movement reappeared



FIG 4—Case II Callus evident in Fig 3, twenty months later

†I am indebted to Doctor Beplester for the history and to Doctor Meigs for X-ray photographs of this case

suddenly, forcing him to keep at rest for eight days. The mentioned swelling increased gradually and at the same time the knee became stiff again. Since two weeks he walks about. The pain on movement decreases slowly. The swelling remained unchanged.

June 18, 1925, thirty-four days after the accident, general physical examination negative. The middle third of the left thigh at the antero-lateral aspect somewhat diffusely swollen, covered with normal skin. In the middle of the swelling, under a layer of somewhat hardened muscle a hard irregular mass is to be felt, not grown together with the skin, but apparently attached to the shaft of femur. The mass measured about 12 cm. in length, was about 4 cm. broad, indistinctly limited, its borders tender on pressure. Flexion at the knee-joint possible only to about 125 degrees. Extension of

the knee, also movement in the hip-joint normal.

X-ray photograph shows at the damaged region a spotted shadow indistinctly and irregularly limited, separated from the femur by a narrow zone of light. The femur bone was unchanged.

Diagnosis: Myositis ossificans of the quadriceps muscle. After a month the symptoms disappeared without any treatment excepting the circumscribed swelling.

CASE VII—J. C. aged sixty-five, a farmer. Has never been seriously ill. Five weeks ago (December 29,

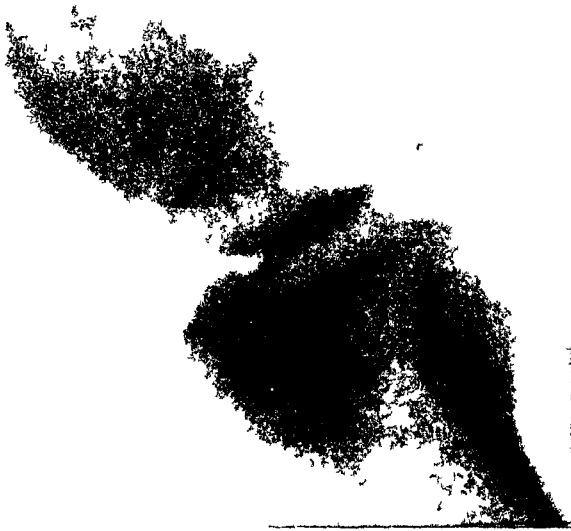


FIG. 5—Case III. Prostern bone in the quadriceps muscle.

1924) his right arm was bruised strongly by a passing carriage. At the moment of trauma he felt a severe pain and præsthesia in the fingers. Soon after the accident the arm became swollen and later discolored, but he was still able to work for another two days. Then he was obliged to stop working owing to pain when moving the arm. Within two weeks the diffuse swelling disappeared, but above the external condyle there remained a hard mass, slowly increasing in size. At this time the right hand began to lose strength and the fingers stiffened as well as the elbow-joint.

Examination February 1, 1925. A badly nourished man. General examination negative. At the external aspect of the right arm about three fingers above the external condyle of the humerus is palpable a mass, large as a hen's egg, somewhat irregular in outline, tender especially at its lower extremity, apparently attached to the bone. The skin above it is unchanged. Extension of the forearm considerably limited. Flexion not hindered. Active extension of the hand and of the fingers in the inter-

phalangeal joints impossible. Flexion possible but with very little strength. Passive movement normal.

X-ray examination showed a not homogeneous irregular shadow nearly 8 cm in length 1½ cm in breadth in the muscles of the distal external half of right humerus separated from the list with a light area about 1 mm in diameter the outline and structure of bones forming the elbow-joint unchanged. (Detection of the right radial artery) (Fig. 8.)

Diagnosis: Ossifying myositis causing a paresis of right radial nerve.

Wassermann reaction negative. Blood coagulation time 6 minutes. Calcium contents of blood measured with the method of de Ward 35 mg per cent ¶.

At the operation (February 5, 1925) an incision was made over the mass exposing the radial nerve just below the mass. The nerve was running through the middle of the mass. The nerve was freed by dissection and the mass separated from the periosteum of humerus and removed.

As the periosteum was found thick-



FIG. 6.—Case IV. Destruction of the hip joint. Sacro-pneumothorax and of the

ened, it was cut away. The cortex of the bone was normal. The removed mass was of cartilaginous consistency (could be cut with scissors) its surface was grown together with bundles of the brachioradial muscle.

The post-operative course uneventful. After two weeks extension of the fingers became possible and one month later the function of the hand was quite normal. The extension of the elbow-joint improved also.

April 8 a recurrence the size of a small nut at the upper end of the incision was noticed but without any disturbance of the function of the arm.

Microscopic examination of the removed mass. A section just over the periosteum at the bases of the mass showed connective tissue partially rich in blood-vessels and cells partially more fibrous with but few vessels. Amidst this connective tissue there are bundles of muscle mostly degenerated and separated from each other by connective tissue. In the last trabeculae of spongy bone surrounded or bordered by osteoblasts. Connective tissue near the bone trabeculae contains a mass of nuclei arranged concentrically

¶ Cf. C. G. W. J. de Ward, *Ann. N. Y. Acad. Sci.*, 1925, 26, 1-10.



along the bone plates. It would suggest that osteoblasts and bone were arising from the named cells. The bone plates containing definite lacunæ have had typical bone structure or were osteoid tissue. At some places slight evidence of cartilage in the centre of bony plates or bone tissue resembling a cartilaginous structure, with many round lacunæ. The marrow was composed of very loose connective tissue, in which were met at times enlarged sinusoid blood-vessels and areas of hemorrhage. The connective tissue of the marrow seemed to arise distinctly from the fibrous tissue, surrounding the

bone plates (Figure 10)

Many other sections from other parts of the mass corresponded to the description as above.

#### CASE VIII—R.

M., aged twenty-five, a workman. No definite history of any injury could be elicited. Was occupied a considerable time at mending telegraph wires. At this work his both (upper) arms became somewhat painful on movement for some weeks. At the left arm the pain slowly subsided and then he noticed in the substance of the muscle a hard not tender mass, causing but little discomfort by flexing the elbow-joint. Up to date the mass has



FIG 7—Case V Ossification of sacrospinous ligament at the trochanter minor Deforming changes

remained unchanged. The spontaneous pain at the right arm lasts until now.

Examination, April 4, 1925. A well-developed man. A bony hard mass is palpable in the substance of the biceps muscle of the left arm, tender by strong pressure only, about 10 cm long, thick as a finger, not connected with the shaft of humerus. The limits of the mass were distinct when the muscle was loose, but not when contracted.

Röntgen-ray examination showed. In the left biceps muscle a bony mass, measuring 9 cm in length, at the lower extremity  $1\frac{1}{2}$  cm at the upper  $\frac{1}{3}$  cm wide from the shaft  $1\frac{1}{2}$  to 3 cm distant, sharply shaped, of not homogeneous consistency. The humerus bone and the neighboring joints unchanged. (Fig 11)

Diagnosis. Ossifying myositis at the biceps muscle of the arm. Was not operated because he felt little discomfort.

CASE IX—J K., aged twenty-four, a workman. Eight weeks ago struck on his left elbow from behind and then typical traumatic symptoms. X-ray examination, December 22, 1924, shows the outline of the left olecranon irregular, deformed and

roughened but without any destruction of cortex. X-ray taken above the top of the olecranon a shadow about 2 cm long, 1 cm broad irregular in shape of not homogeneous density (Fig. 12).

The region of olecranon enlarged and tender. Pyralis to the extent of a hard mass, the size of a nut by pressure tender when the muscle is relaxed somewhat movable from side to side. The movement in the elbow joint limited.

Diagnosis: Myositis ossificans in triceps muscle. After some weeks the movement improved. No operation.

CASE X—M. L., aged twenty, female. The family history insignificant. Has never been seriously ill. Fell and struck her left elbow seven weeks ago. Just after the accident the elbow became swollen and tender and could not be flexed. Since that time no attempt at reposition has been made. The diffuse swelling disappeared after some days, but the limitation of motion and discomfort when attempting it remained.

Examination, April 4, 1925. A well-nourished female of middle stature. Internal organs negative. Left arm extended, forearm fixed at about 135 degrees. The region of the elbow irregularly outlined and deformed. The skin over it pigmented. The lower end of the humerus could be felt in the cubital fossa, but somewhat irregular in shape and size. Both forearm bones dislocated backward. The motion was considerably limited.

X-ray examination revealed backward dislocation of both forearm bones. At the posterior surface of the lower end of the humerus under the triceps tendon and along the articular surface of the humerus anteriorly, a shadow not homogeneous and irregularly shaped. Diagnosis: Myositis ossificans after backward dislocation of left forearm. (Fig. 13.) Calcium salts content in blood 15 mg. per cent.

At the operation performed April 14, 1925, after transverse section of the olecranon was found a mass of scar tissue of cartilaginous consistence 1 cm. thick connected closely with the external surface of the articular capsule. At the front of the elbow-joint also the articular membrane was even at its inner side and on dorsal outflow from outward grown close with similar masses occupying a space between the neck of the humerus and the brachialis internus tendon and substance. The procedure in the upper arm appeared normal.

FIG. 8—CASE VII. Triceps defect in retractor for humerus.

*Microscopical Examination*—A transverse section of the mass removed from the anterior part of the joint capsule showed at the inner surface a fibrous connective tissue with typical cells and fibrille, the last running parallel to each other and to the joint cavity. Nearer to the middle of the section the connective tissue became loose and vascular and contained more cells. The last gradually losing their spindle shape, appeared more regular and then round. The intercellular substance also assumed slowly a more homogeneous hyaline appearance and color of a cartilage. Thus the connective tissue there transforms without distinct limits into cartilage, forming in the section a long homogeneous plate. The cartilage in the other half of the section ossifies, adjoining without distinct limits to an island of spongy bone, irregular and oval in



FIG. 9.—Case XVII. Microphotograph of the mass removed from the laparotomy scar. Transversal section (50 $\times$ 2).

shape. Between the trabecule of typical bone there were large marrow spaces filled with a vascular loose connective tissue. The trabeculae were in some places, especially at the outer side of the plate, encapsulated by connective tissues rich in round nuclei and signs of quick growth and contained here and there traces of cartilage in their centre, surrounded by typical bone or osteoid tissue. At the outer side of the bone island the transition of bone structure to a cartilage or fibrous tissue is not sharp. The last shows there many places of inflammatory infiltration and abundant formation of granulation tissue.

In other sections near to the former abundant focus of inflammatory infiltration and granulations tissue in various degrees of maturation were seen close to scar islands, very poor in vessels and cells, but no traces of ossification. There were also numerous remains of old hemorrhages.

All this would suggest that the primary appearance were inflammatory changes near to the joint capsule and within itself. The young granulation tissue, originating from the joint capsule organizes the hematoma and crushed tissue pulp in the neighborhood, transforming itself into fibrous tissue, cartilage and at last into bone.

CASE XI—W. P., aged twenty-two, a workman. Dislocated both forearm bones backward at right elbow-joint six years ago. Since that time the elbow became nearly stiff and deformed. Every attempt to move it was painful. Some weeks ago the pain increased in intensity. No attempt at reposition had been made.

Findings, November 14, 1924. Right elbow fixed in extension of about 135 degrees. The outline of the elbow-joint indistinct and much deformed. The muscles of the arm and forearm considerably atrophied. In the cubital fossa palpable the articular end of the humerus somewhat irregular and thick shaped. The triceps muscle tendon and distal part of the muscle itself hard and fixed. The active as also passive movement nearly entirely absent.



and movement after ceasing of tenderness Five weeks later a second X-ray examination showed the shadow became somewhat smaller, more distinct and denser The limitation of motion apparently diminished

CASE XIV—M N, aged sixty, a female Fell and struck on her right shoulder a year prior to examination Since that time discomfort and impairment of motion at right shoulder-joint, in last few months gradually increasing

X-ray picture revealed a deforming arthritis of the right shoulder-joint and ossification of the sacrospinous ligament On skeleton bones no traces of fracture

CASE XV—W S, aged thirty, a sportsman Has ridden horseback habitually for many years In 1916, acute polyarthritis In 1921, at war, wounded on right thigh The wound healed rapidly without any complication The same year febris recurrens Dur-

ing last seven years a prostatic callus developed at both arm muscles and at right thigh after exercises At first the symptoms followed their usual course After a time the bone masses disappeared In 1923, after running some distance, pain and swelling on both thighs, especially at the left one, suddenly appeared He was treated for some weeks in the military hospital A hæmatoma was then found in the antero-lateral muscles group of the left thigh The hæmatoma recurred after some punctures There developed then an abscess and in the pus a bony sequester was found Repeated X-ray examinations of bones of the skeleton were entirely negative After treatment with autovaccine the wound healed

The patient was otherwise completely well Exami-

FIG 11 —Case VIII Myositis ossificans in the biceps brachii muscle

nations of urine, blood, internal organs were essentially negative There was also no constitutional disease

I am indebted to Doctor Janusz (Lwow) for the history of this case

CASE XVI—Dr H Schuster at the Institute of Pathological Anatomy of the John Casimir University, found (July 22, 1925), in a post-mortem examination of a forty-six year old man, M F, being a prisoner, a chronic inflammatory process along the whole length of the vertebral column with scar and bone formation, occupying the substance of both iliopsoas muscles, especially at the right The periosteum of the vertebræ, as well as the perivertebral tissues were thickened and uneven The muscles substance was hardened, as if inflamed, and contained several scar islands, and among them many narrow-bone trabecule arranged longitudinally to the muscle fibrillæ, appearing in a transverse section as about one month old callus The particular vertebræ were normal in outlook, not inflamed or deformed

In addition the retroperitoneal, mesenteric, the cervical and left axillary glands were enlarged, pale, hard, and surrounded by a hard connective tissue, grown closely with

the glands. There was also an endocarditis verrucosa recens of the semilunar valvulae, a chronic slight endocarditis of the tricuspid valvulae, a hyperplasia and enlargement of the heart, an ascites and hydrothorax of both sides with subsequent atelectasis and compression of both lungs, a chronic fibrous partially ossifying leptomeningitis, a haemostasis in liver and kidneys and a papilloma of the stomach. Other organs normal.

The man was treated a week before he died in the internal department of the General Hospital of Lwow and to Doctor Ciepiclowski I am indebted for the history of this case.

There was no constitutional disease or a serious illness in the past. For a considerable period of time he experienced pain in the abdomen. Then developed a swelling of left upper extremity and left part of the thorax later of the abdomen and about a week ago both lower extremities became swollen. He drank much prior to the war.

On examination, July 17 1925. Lymphatic glands of left supraclavicular fossa and of left axilla enlarged small nut size, not attached to the skin. Both pleural cavities filled with a free fluid reaching the level of the middle of the scapula. Free fluid in the abdominal cavity. Swelling of left arm and both lower extremities.

Blood examination. White cell count 12,000. neutrophile polymorphonuclear leucocytes, 88 per cent, lymphocytes 8 per cent, mediate forms 4 per cent.

Neurological examination. Hemiplegia cruciata. Paresis of right facialis nerve, paralysis of left upper and paresis of left lower extremity.

Microscopical examination of the removed psoas muscles has given unexpected result, it showed an endothelioma malignum. There were foci of neoplastic cells, different in size lying within fibrous connective tissue. The last, growing between the muscle fibrilla, compressed them causing their atrophy and destruction. Otherwise many islands of cartilage, osseous and bone tissue, passing into each other and into connective tissue, without distinct limits, originated undoubtedly from connective tissue, forming the stroma of the tumor. Nowhere traces of inflammatory infiltration were found.

CASE XVII—F. M., aged forty-nine, a farmer. Family history of no importance. When he was twenty years old icterus. For a considerable period of time suffered from stomach trouble. Fifteen months ago (June, 1923), a gastrectomy was performed.



FIG. 12.—CASE IX. Traumatic ossification in the triceps humeri muscle.

in our Clinic because of chronic gastric ulcer (Microscopical examination of the specimen was then not done) The post-operative course was normal, the skin incision healed by primary intention, without inflammatory reaction and patient felt completely well for nearly a year Then he noticed an enlargement of the upper left part of the abdomen and a hard not tender mass at the middle of the scar A month before his readmission to the Clinic the pain reappeared after taking food

At the examination, December 11, 1924, was found A badly nourished cachectic man



FIG 12 —Case X Posterior dislocation of the elbow Ossification of the joint capsule and under the triceps tendon

be an inoperable carcinoma The abdomen was closed in layers The post-operative course was uneventful

*Macroscopically* the removed bone appeared about 6 cm long, 1 cm large, at the anterodorsal aspect slightly bent, according to the depth of epigastrium, flat, very hard, at the lower extremity somewhat wider connected strongly with the scar tissue of the white line, proved to be more resistant to decalcification than a tooth tissue (Fig 17)

*Microscopical Examination*—At the transversal section of the mass there was at the circumference an abundant fibrous tissue, containing in some places traces of hemorrhage and degenerated muscle fibrillæ The middle of section occupied an island of typical bone, oval in shape, size  $\frac{1}{2}$  by 0.3 cm The bony tissue had the character of compact bone showing the typical Havers canaliculi and lacunæ arranged concentrically along the Havers canaliculi as in normal bone The vessels of the canaliculi were connected with the vessels of the neighboring tissue, the latter being very vascular in such

Head, neck and chest negative At the enlarged upper part of the abdomen a tumor was palpable, occupying a space between both nipple lines sideward and two fingers below the navel, hard, slightly tender by pressure, moving only little with breathing At the middle of the laparotomy scar which was smooth and thin, beginning one finger breadth below the xiphoid process, ending at the level of umbilicus, a mass was lying within the fascia, about 6 cm long,  $\frac{1}{2}$  cm thick somewhat more on the left side of the white line situated, not tender, not attached to the skin, giving in X-ray picture a definite shadow A carcinoma of the stomach probable

At operation, December 18, 1924 the hard mass from the scar was removed It proved to be a bone, surrounded by scar tissue By removal of it the capsule of right rectus muscle was opened The mass in the abdominal cavity proved to

places contained numerous large nuclei, as in the preceding cases. The entire bone island sharply limited from the enveloping tissue has had at its margins in some places a layer of osteoblasts, forming apparently a new bone. Far from the bony plate there was a group of giant cells arranged round a foreign body, probably a piece of cat-gut ligature.

*Classification* — According to the last probable cause due to the development of parosteal bone, myositis ossificans could be divided into the following groups

1. *Myositis Ossificans*

*Pneumatica* — a Bone formation following a severe single injury by blunt force. This is the most frequent form one meets with. Schultze found it 232 times out of 290 collected cases. It is common in some occupations as horse servants, workmen, sportsmen. As the most frequent trauma was noted a stroke with a horse shoe by the tail of a heavy object or by falling. To this group belong our Cases II, III, VI, VII, IX. This form develops most frequently in the anterior and lateral aspect of the thigh and upper arm. Very rare are such localizations as pectoricus muscle (Graf Carleton, Bowen) masseter (Porchart), or as



FIG. 14 - C. XI. Seven years after posterior dislocation of the elbow. Extensive ossification of the joint capsule and under the triceps tendon.

temporal, gluteal or thumb muscles (quoted by Strauss). To this group belongs also ossification of joint capsule and ligaments following a single blunt injury as, for instance, ossification of coraco-acromial ligament reported by Marshall, ossification of trapezoid and conoid ligament by Grune, ossification of shoulder-joint capsule after a trauma by Nowakowski, and others.

b. *Myositis ossificans* subsequent to dislocations develops most frequently after backward dislocation of the elbow till 60 per cent in brachialis internæ muscles, according to Machol. Our Cases X, XI, XII, XIII, here included. It has been observed also as a rare complication of a supra-acromial dislo-



cation of the clavicle (Strauss), after luxation of the hip (Ewald), of the knee (Noble), and of the shoulder (Regnier)

c Development of bone along the track of perforating gunshot wounds, when the projectile either did not injure the bone or only touched it

d Myositis ossificans after clean incised wounds Its appearance after clean incised abdominal wall wounds at the white line following operations on the stomach is the commonest one and was described several times, by Roepke, Sabjakina Capelle, Wollenberg, Nierenberg, Rokitsanski, Strassberg, Rixford,



FIG 15 —Case the same as in Fig 14

Clairmont, Rubesch, Lecene, Painter, Clarke, Hannes, Coenen, Gruber, Borch, Gallagher, Mebius, Lewis, Eiselsberg, Noble and others This form, otherwise very rare, has been seen also after a suprapubic prostatectomy by Lewis, after a herniotomy by Jones, after puncture wounds by Bender, Werner, after incised wounds of the thigh by Cranwell, at the glutei by Schwarz

2 *Myositis Ossificans Chronica*—a The bone formation occurs after repeated slight injuries To this group belongs the "rider's bone" in abduction muscles, fol-

lowing steady irritation at horseback, the cavalymen bone at the outer side of the thigh from sabre hits (Ludwig, Binnie), the soldier's bone at the shoulder from rubbing with the rifle, etc "Exerzierknochen" of the German authors at deltoid muscle and biceps, "Bajonettierknochen" at the pectoralis muscle, and "Turnknochen" in biceps muscle The condition is very common in some armies, according to the method of training the soldiers Hasse, for example, recorded 16 cases among 600 German soldiers, when Bowen could find only two in the U S A Cavalry To the above-named group belongs my Case XV

b Bone formation owing to occupational overstraining of some group of muscles, occurring among joiners, shoemakers (Haga and Fujimura) This group is demonstrated in Cases VIII, and to some degree I The former

worked hard mending telegraph wires, the last was a joiner overstraining his thigh muscles with a lever. No history of a single severe injury could be elicited in both of them.

c. Myositis ossificans circumscribed, spontaneous, when even a single or repeated slight injury can be excluded, very rare, if existing at all.

3. *Myositis Ossificans of Infectious Origin*—Ossification of muscles being a seat of a metastatic abscess, as described by Noble, Elmslie, Whitelock, after a pyæmic abscess or a phlegmon of the forearm as reported by Roskowski.

4. *Myositis Ossificans Para-arthritis*—A form so far as I could find, not described till now. Here belong my Cases I, IV, V, XIV. Bone formation in muscles and tendons occurs near to joints arising of a chronic inflammatory process, as arthritis deformans or tuberculosis. In none of these cases was any form of injury related. The cause was either the chronic inflammation in the neighborhood or the factor exciting the main disease.

5. *Myositis Ossificans Neurotica* (Ostrasis, Steinert)—Development of ossification of muscles and tendons subsequent to tabes, syringomyelia (Ludloff, Tomaszewski), traumatic paraplegia

(Israel, Zanolli, Geldmacher), and myelitis (Kuettner). Little disease (Horvath), located mostly in the upper arm muscles by patients suffering from syringomyelia, and in thigh muscles from other named diseases, very rare in calf and forearm, mostly multiple, being probably due to increased opportunity to injuries or to trophic changes.

*Course*—The course of myositis ossificans traumatica is a typical one and can be divided into three stages. In the first typical traumatic symptoms are predominant. They subside within a few days, only limitation of movement,



FIG. 16.—Case XII. Ossification in the brachialis internus muscle after posterior dislocation of the elbow.

improved somewhat with the ceasing of traumatic symptoms, does not disappear entirely. In the second stage at the end of the second week or later, according to the care and rest given to the damaged region, the pain, spontaneous and on movement reappears, the impairment of motion increases and the circumscribed, somewhat not elastic, swelling becomes slowly larger. There are either no, or very little symptoms of inflammation in this stage. Three to four weeks after the injury the Röntgen-ray examination reveals a faint shadow, irregularly and indistinctly limited, not homogeneous, with darker and lighter areas, situated parallel to the shadow of the bone of the skeleton, but separated from it by a light zone, present also in cases in which an attachment to bone is certain. There is a marked incongruence between the size of the palpable mass and its size in the X-ray picture, as in my Cases II, VI, VII.

In the third stage the growth of the mass stops or the lump increases slowly by periosteal apposition. The pain disappears or remains unchanged. In X-ray pictures the shadow is more homogeneous, intense, sharply limited and at times smaller than before. The duration of the growths time of the mass is variable from ten weeks to six months.

As a rule there is no fever in the course of myositis ossificans. There are but few cases known in which were marked inflammatory symptoms as in cases of Itzerot, Salmann and Peiser. There were also very rare cases in which the ossification developed some years after injury as in the case of Chaton and Cullods forty years after a trauma.

In other forms of myositis as myositis ossificans chronica ossification after laparotomy wounds neither the patient nor the physician could determine precisely when the mass began to develop. In laparotomy scars the bone was found earliest at the end of the third week after the operation. Rider bone and similar forms appeared mostly after three to four months.

FIG 17 — Case XVII. Bone formation in the laparotomy scar. X-ray photograph of the removed mass.

*Pathology*—The parosteal bone may be different in form and size. There have been irregular masses of some cm. to plates occupying a part or even the whole of a muscle, surrounded usually by a strong connective-tissue capsule, periosteum-like, many cm. thick, grown together with the muscles, degenerated within the mass to some degree.

The mass was lying either separated from the shaft without any bony or connective-tissue attachment to it or grown to the bone by a connective-tissue band, therefore but little movable, or by a bony pedicle attached to skeleton bone. The pedicle can be large or narrow, joining the mass to a bone of the skeleton at one end, or in the middle. It is not seen in the recent cases in the X-ray picture because it is still porous and without calcium deposits. It does appear when the callus is quite mature.

In some percentage of cases, according to Strauss, up to 10 per cent, the new bone contained a cyst filled with a light yellowish, sometimes reddened synovia resembling fluid. The cysts were always placed at the lower extremity of the thigh, but in the case of Nimici the cyst was found in the brachialis internus muscle. Such cysts were reported by Rammstedt, Schultz, Vulpius, Wolter, Busse and Blecher, Zhuber, Van Ohrog, Nimici, Strauss, Berndt and others.

The microscopical picture of myositis ossificans is very characteristic: there is an irregular mixture of bone, cartilage, muscles and connective tissue. The usually spongy bone forms variably shaped trabeculae surrounded by connective-tissue layers of differing amounts of inter-cellular substance and sometimes by mostly discontinuous rows of osteoblasts. The bone plates seemed to arise from the connective tissue either directly, the fibrous connective tissue beginning in some place to lose its structure becoming homogeneous and changing by deposition

FIG. 18.—Free, two week old callus after fracture in a man aged twenty.

of calcium salts and converting the fibroblasts into bone cells without any distinct limit into osteoid or bone tissue, or indirectly the bone trabeculae arising from connective tissue by cartilage stage. The muscle, according to most writers plays no active role in the whole process: it becomes compressed by newly formed connective tissue and undergoes degeneration. Busse and Blecher only assume that the muscle cells are converted into connective-tissue cells and then into bone. In later stage there are no signs of rapid growth, but contemporary to the resorption by giant cells the bone increases by periosteal or osteoblasts apposition at margins. In most instances no, or but small, signs of inflammatory nature were found. But according to Borchardt it is due to the late period of the process. In the early stage marked inflammatory reaction could be confirmed microscopically. It would be of interest to

remember that the same pictures and stages were seen, according to Lexer, also by the study of the progressive form of myositis ossificans, and, similarly and in the same period of time by callus formation after the fractures of long bones, as stated by Bancroft in his experimental work

*Diagnosis*—The diagnosis of a well-developed stage of ossifying myositis is not a difficult one and can be made with a high degree of certainty, but in the early period it requires great care. Many conditions giving a similar picture must be excluded, as a hæmatoma, muscle callus, muscle tumor, osteomyelitis, interstitial syphilitic process, periostitis, traumatic and infectious, fractures and neoplasms. The differentiation between a muscle callus and inflammatory infiltration of the muscle may be impossible even with X-ray examination. The traumatic exostosis, as described by Weber, Virchow, Volkmann, Luecke, Billroth, Pels-Nelsen, Delbet, vary but little from myositis ossificans and often a distinct limitation from each other can be very difficult even impossible at all, especially from quickly growing forms as reported by Honsell and Schuler, Sieur, Delorme, Cahen, Mollier, appearing within two weeks following injury as a large pedunculated mass located over the shaft of a bone, sometimes very tender. The only difference is then in the want of near relation to the muscles. My Case II corroborates the view of Oliver, Bowen and others, who assert that ossifying myositis and traumatic exostoses are identical.

Most important and sometimes very difficult may be a differentiation between a myositis ossificans and a sarcoma. Before Röntgen-rays were known, such fatal mistakes were common, and according to Finney reached to 50 per cent, and according to Bull even 75 per cent. Both conditions have many points alike: both develop in young persons after a trauma, grow quickly and are of hard consistency. The period of time passing from injury to the development of the mass can be also equal. Some authors as Strauss, Coley, maintain that the localization of the disease can be also of diagnostic value, sarcoma, for instance, is usually located near the epiphysis, while myositis takes place over the shaft. This affirmation seems to me unreliable. I have seen a sarcoma placed over the shaft of the femur, giving an X-ray picture exactly like to the Case VII of myositis by Lewis. But there are other differences. Steady growth of the mass and infiltration of soft parts, late spontaneous pain with tendency to increase, unequal consistency by palpation are signs of a sarcoma. Inclination to shrink and diminution of the swelling of soft parts, early pain, lessening slowly in severity, equal hard consistency to touch are symptoms of myositis ossificans, emphasized by many authors (Noble, Coley, Bloodgood), leading considerably to right diagnosis. The most significance attaches to the X-ray examination. In myositis the cortex of bone and periosteal line are even and unchanged, the new-formed mass gives a shadow parallel to the margin of the cortex separated from it by a light zone, as it is evident in my Cases II, VII, IX. In sarcoma there are very early medullary changes and destruction of cortex, the bony mass trabeculæ running obliquely or transversally to the shaft and

are visibly connected with it (Lewis, Coley), when the diagnosis remains still doubtful exploratory incision is indicated. It can be, however, not decisive, as advocated by Bloodgood and confirmed through the case of Paul.

*Complications*—The complications vary with the seat of the mass. Located over the shaft they cause usually slight discomfort and limitation of motion as in most of my cases. Placed over or near the joints, they interfere sometimes considerably with the function of the extremity. Most common are such complications after posterior dislocation of the elbow where often but traces of motion are present, as in Cases X, XI, or the joint is entirely stiff. Similar was seen in other joints. In hip-joint in case of Graf, in shoulder-joint in case of Nowakowski and others.

Complications such as in my Case VII, where the lesion was followed not only by spontaneous pain and limitation of motion at the elbow, but also of the hand and fingers, as a sequel of paresis of the radial nerve, are not common. Similar cases were reported by Décloume and Yvert: a parosteal callus after posterior dislocation of the elbow compressed the brachial artery and the median nerve with circulatory disturbances and paresis. According to de Witt thrombosis of popliteal artery, and in case of Koester, a gangrene of the foot developed in consequence of a parosteal bone formation at the popliteal fossa. Twice a transition of a myositis into sarcoma was observed by Da Costa and Coley. By the last six years after an injury and three years after a microscopically ascertained myositis. The case of Paul is not distinct enough.

*Anatomic Distribution*—To the development of a parosteal bone some regions are particularly disposed. Specially where the bone is covered with a thick layer of muscle, where the last insert broadly into the periosteum and near to joints, as on the thigh anteriorly and sideward, as the quadriceps and adductor muscles, and on the arm, the brachialis internus and triceps muscles. In Rammstedt's statistics dealing with 14 cases, 11 occurred in the thigh muscles, 2 in the upper arm, 1 in the gluteal muscle. Strauss found among 127 cases, 43 in the quadriceps, 13 in the adductor muscle, 64 in the flexor muscles of the upper arm, 2 in the masseter, 2 in the gluteal muscles, 1 in the muscles of the ball of the thumb and 1 in the temporal muscle. According to Jones, who named 339 cases, the brachialis internus, adductor, and biceps brachii muscles are the most frequently affected.

In my material, 5 occurred in thigh, 8 in upper arm muscles, 1 in a laparotomy scar. It is surprising that myositis does not affect the regions most frequently exposed to an injury as the lower leg or forearm in which there is an easy occasion to periosteal lesion. Its appearance in these regions was noted in some rare instances, as by Chaton and Caillods in leg, by Whitelocke in soleus muscle, by Noble in flexor carpi muscle, by Salmann and Peisser in iliopsoas muscle and by Roskowski in the forearm muscles.

*Age*—In most instances myositis ossificans developed, according to Noble, Strauss and others, in middle life, between 15 and 25 years. In Strauss' statistics the youngest patient was 12, the oldest 50 years of age. Fay has seen

myositis in a boy 5 years old and in a man 57 years old, and Graf, Weinlechner, and Lewis in 70-year-old men

In my cases 7 were under 25 years old, and 10 over 25, and between them 3 over 60 years old. If we put the cases after posterior dislocation of elbow separate, there were 4 cases under and 9 over 25 years old

*Treatment*—In early times when myositis ossificans was insufficiently known and especially when it was often mistaken for a neoplasm, it was treated by radical operative measures, regardless of the stage of its development. Helferich advised to treat it as a malignant tumor by excision in healthy parts, Schuler, Regal and others, were for an operation if the mass increases, Delorme advised sparing extirpation and Lapouette favored excision after six to eight weeks from the beginning of the disease. On the contrary most of to-day's surgeons recommend conservative treatment, in the early stage of the process especially, and even in later periods they are for to "leave it alone" unless it interferes with the function, for myositis has the tendency to shrink or even disappears completely without any interference as reported by Wendt, Vollhardt, Rowley, Strauss, Bristow, Thiemann, Wichmann, Rassmussen, Delorme, Lelasque, Schultz, Nadler and others. The early operations were often followed by recurrences, mostly, however in cases of broad attachment to the bone of the skeleton (Blecher, Rotschild, Berndt, Schultz, Strauss, Painter, Morley), my Case VII. At the early stage of the disease it is very difficult to deal with tissues changed in outlook and anatomical position, imbibed with blood, therefore with tendency to become infected. One must also consider that inflicting another injury to parts inclined in that period to ossification, one may renew the activity of the morbid process (Wilms, Guleke, Godlee).

Early operation can be indicated in such cases as my Case VII, regardless of the possible recurrence, when waiting can result in an irreparable damage of the function of the extremity, however there are few cases where a strictly conservative treatment was followed by recovery (Delorme). In my case appeared a small recurrence at the upper end of the incision, which was not disturbing and there was no cause to regret having done an early excision of the mass.

In most cases a simple excision of a mass being stationary, as advocated by many authors, is sufficient to bring recovery. Morley, in agreement with his explanation of genesis of myositis, advised excision combined with grafting of the deep fascia on the denuded bone surface. In my case, however, as reported above, the periosteum was curetted away, where it was covered with the mass, the recurrence did not develop there, but above, where the periosteum was not removed.

The conservative treatment must conform with the stage of the process and the region in which it developed. According to Noble, in the period of traumatic symptoms in a region inclined to development of myositis ossificans prophylaxis is most important. The damaged region must be kept in rest. Where a reposition of a displaced joint must be made, it should be done with

a minimum of trauma. Briefly "In the first stage reduce the trauma to minimum." There advised aspiration of the hæmatoma or even an incision and drainage. In the stage of bone development and growth also rest is essential, for even slight traumata, as massage and slight movement, were sufficient to raise the activity of the morbid process, as confirmed by cases of Rotschild, Berndt, Busse and Blecher, Nowakowski. There are but few cases reported in the literature, when the extremity was in rest during the critical days as cases of Borchardt and Ellbogen, and the bony mass developed nevertheless. Undoubtedly early movement influences the size of the mass.

When the mass becomes stationary or begins to decrease, energetic osteopathic treatment is to be employed.

Among other measures X-ray therapy was tried by Neff, fibrolysine injections by Grosskurth and injections of pepsin solutions by Karell.

*Etiology*—The question why myositis ossificans occurs relatively so rarely in comparison with the frequency of injuries, why it tends to develop in some particular regions and not in the most frequently injured, as the lower leg, from where does develop the new-formed bone, are not solved sufficiently till now.

A number of theories have been advanced to explain the genesis of myositis ossificans. They all could be divided in two groups: the one assumes parosteal bones are arising from the periosteum of the neighboring bone, the other advances a metaplasia of local connective tissue.

The theory of periosteal origin of parosteal bone, initiated by the works of Ollet, by experimental studies of Bertier, advanced by Berndt, Sudeck, Pochhammer and others, advocated by many authors as Rasmussen, Delorme, Berger, Sieur, Schulz, Berndt, Lewis, Lyot, Finney, Jones, Bode, Louis, Roepke and many others, is based upon clinical observation, there are many cases of myositis where the attachment of the bony mass to a skeleton bone was proved both clinically and at the operation. Also the Röntgen-ray investigation of Kemboeck, Kalb, Haberland and others, seemed to confirm this idea.

The parosteal bone formation may be accomplished by many ways. Berndt believes that a severe blow crushes the muscles into a pulp and injures the periosteum opposite to it. The osteoblastic layers of the periosteum proliferates then, the osteoblasts escape into the crushed area of muscle and there form a bone.

Lyot's theory, according to Bowen, is "A muscle in action, receives a blow, some of its fibres tear themselves from their bony origin and retracting into the mass of muscle still connected with the bone, carry with them particles of periosteum. These particles grow in their new environment, are true bone grafts, and can form intramuscular osteomata, unconnected with, though originating from the periosteum."

Morley's theory is described by Bowen as follows: "A severe blunt injury at once subcutaneously strips off and destroys the periosteum and crushes the muscles in contact with the bone. Bleeding occurs from the sui-



face of the denuded bone and with the blood osteoblasts, in a free and possibly ameboid condition, escape into the pulped muscle tissue and blood and there produce a growth of bone. Healthy muscles left in contact with denuded bone form protective fibrous adhesions from their interstitial connective tissue and take on the limiting function of the periosteum. But severely contused muscle tissue mixed with blood provides a favorable pabulum for an osteoblast."

The importance of a hæmatoma was also advocated by Schultz, Delorme, Vulpius, Duems, Sudeck and others. Pochhammer tried to confirm it experimentally. He formed a pocket from pedunculated periosteum flaps on rabbits, filling it with coagulated blood, and was able to state that bone developed only in spaces filled with blood clots. When the growing new bone comes in contact with healthy tissues it stops. The shape and size of the ossification are dependent therefore upon the form and size of a hæmatoma. It remained to confirm whether the periosteal stripping by a trauma really occurs and if the periosteum retains in such conditions its osteoblastic power. Sudeck attempted to solve the first question with regard to the posterior dislocations of the elbow. He found in experiment performed on cadavers, that in backward dislocations of the elbow, the injury of the capsule and periosteal stripping occurs almost constantly, usually at four points: over the posterior surface of the humerus, above the olecranon fossa, above the supratrochlear fossa, and over both condyles. Marcus and Gale, however, quoted by Strauss, state that immense force is necessary to detach the muscles from the bone. Koenig and Beindt believe it also to be impossible: it is easier to break off a piece of bone than to detach the muscle from the bone. Kuettner, Lever, Strauss, Stone (the last quoted by Bowen), observing the fact that myositis occurs in muscles attached broadly to bone without a distinct tendon, are of opinion that it is easier to detach such muscles than those with a strong tendon. The idea of an anatomical disposition of a region to bone formation is thus originated. Machol, studying posterior dislocations of the elbow, found in 60 per cent. development of bone there, being due not to the trauma of dislocation itself, but of the reposition. I have repeated the experiments of Sudeck on cadavers and found that the stripping of periosteum occurs most markedly over the anterior aspect of the coronoid process of the ulna and over the posterior surface of the humerus. In a minor degree anteriorly above the supratrochlear fossa. The joint capsule passes into the periosteum without distinct limits and after stripping of the joint capsule at its margin, the periosteum detaches from the cortex easily. Microscopically, however, the torn off periosteum contained no osteoblastic layer. By reduction the torn off periosteum becomes more or less accurately replaced and does not cause a parosteal ossification. By unreduced dislocations the parosteal bone formation reaches sometimes an excessive amount as in my Cases X and XI.

The first question can be answered therefore that after dislocations the stripping of periosteum is a sure and almost common appearance. Whether

it occurs also by injury over the shaft remains in question. I was not able to produce it on cadavers of adult dogs, even when the periosteum about the muscle attachment was cut.

In regard to the other question of the osteoblastic power of the transplanted periosteum, it would be necessary to recall some facts. The question was studied by Barth, Marchand, Saltykow, Lexer, Laewen, Lobenhoffer, Frangenheim, Radzimowski, Sultan and many others. Berthier detached flaps of periosteum at the muscular insertion and stimulated the muscles electrically. He found in a period of time up to four months only in some of the rabbits bone formation in muscle. Grohe has seen in a free transplanted periosteal graft, traces of proliferation. After Schepelmann a free transplanted periosteal graft can produce bone, but very limited in size and disappearing after a time.

Martin, Tsunoda, Nakahara, Dilger, and Jokoi were able to demonstrate that the periosteum connected with a plate of cortex forms a new bone. A mass excised from the cambium layer produces no bone, contrary to the opinion of Ollier.

Davis and Hunnicut, quoted by Bowen, on the basis of their experimental study, came to conclusions. "Periosteal transplants in the majority of cases do not produce bone, pedunculated flaps of periosteum produce no bone, except for the pedicle connecting them with the bone, free periosteal flaps and pedunculated flaps with bone shavings attached produce bone in every instance."

Murphy came to similar conclusions. Baetzner found no bone formation in 47 transplantations of free periosteal flaps in grown-up animals among 15, in young dogs only once. Riess believes that in young dogs till nine months, periosteum detaches easily from bone with the osteoblast layer and is able to produce bone.

Lexer and his school made extensive experimental studies on this subject and states that free transplanted periosteal flaps in normal conditions produce no bone, for free transplanted periosteal grafts produce bone only when detached with the osteoblast layer, which is only possible if irritated and showing a proliferation of osteoblasts. To produce a proliferation in experiment is a very difficult matter. Bone production succeeds when periosteum was transplanted with a plate of cortex. According to Koch periosteum of grown-up animals can produce bone if there are osteoblasts on it and when blood-vessels are not cut. The new-formed bone disappears soon, when there is no function for it. Martin, Rode, Willich came to similar conclusions.

Some differences between the results obtained by several authors are due to different methods employed and to the fact that several sorts of animals were used. As is well known, rabbits incline very much to excessive callus formation, while cats occupy the diametrically opposite position. Dogs show a tendency equal to man.

Summing up all above said, one must come to the conclusion that periosteal grafts, free or even connected with muscles, produce bone inconstantly.

and only in young individuals in the period of growth. In adults only if it was torn off in the stage of proliferation of osteoblasts, if inflamed or if taken off with a piece of cortex. In the last instance the new bone grows very slowly and disappears after a time. Such conditions are undoubtedly very uncommon in myositis, for it occurs almost exclusively in individuals of middle age and my cases 41 per cent were above 40 years and 17.6 per cent over 60 years old. For young individuals under 20 years of age myositis is very seldom, as compared with the opportunity to injury. This suggests that the periosteal theory in its present form is not sufficient to explain the development of parosteal bone after a single injury. If it arises from periosteum, other conditions accompanying are necessary, not repeated till now in experiment.

The other group of theories assume parosteal bone to result from a metaplasia of connective tissue.

The theory initiated by Orth is based also upon clinical observation. In most cases of myositis ossificans no connection was found with a skeletal bone even of fibrous tissue. The microscopical finding seems also in many cases to indicate that the connective-tissue cells are converting into bone and cartilage cells. The X-ray examination reveals almost constantly bone formation in large spaces with many points of ossification, a form uncommon to the periosteal ossification.

The existence of metaplasia is well known to pathologists. Metaplastic bone formation has been seen in almost every part of the human body, as in heart-valvulæ, lung, skin, brain, liver, in arteries, glands, etc. (Borst). The connective-tissue cells convert into bone either directly—calcium salts depositing in intercellular substance and connective-tissue cells becoming bone cells, or indirectly by progressive metaplasia (Virchow), connective-tissue cells transforming into cartilage, respectively, bone cells at first and produce then a bone.

There is also no obstacle to assume the ability of connective tissue to convert into bone. The connective-tissue, cartilage and bone genetically arise from the same embryonic layer—mesoblast and transform later into each other. According to Wolter the only difference between all kinds of tissues developing from mesoderm lies in the difference in their intercellular substance and is not sharp. They all react to an injury with formation of a new tissue accommodated to new conditions. The connective tissue incline above all more to a hyperproduction than to a specific regeneration. It refers especially to the intramuscular tissue and tendons.

Koester enrolls the intramuscular connective tissue to tissues of the bearing apparatus (Stuetzgewebe) and assumes that the limit between them may be peripherally displaced. The connective tissue of the muscles, fascia, tendons and ligaments become thus endowed with powers usually belonging only to the periosteum (Ziegler quoted by Bowen) or show a character of a periosteum (Ribbert). Such conditions are to be found in the progressive form of myositis ossificans (Lexer). Osteoblasts may arise from periosteum as well

as from connective tissue (Kawashima, Kaufmann, Bancroft) There may be also an incomplete differentiation between the tissues descending from mesoblast (Stempel, Juengling, Frattin, Blencke)

Metaplasia is not an usual appearance There remained to establish the conditions under which it may occur Many writers called attention to calcium salts Pollack found in 17 per cent of necropsies bone in lung glands besides calcium deposits Cohn, Rosenstein, Rohner, Menckeberg, described also occurrence of bone in artery walls in 8 per cent of old men Barth, Poszaryski, Sacerdotti and Frattin, Roepke, have also seen true bone in calcified glands Liek made extensive experimental investigations on kidneys of rabbits and came to the conclusion that a bone develops always where a young connective tissue adjoins a calcified one Bone formation follows therefore a necrosis and calcification Roepke supposes that while an injured extremity is resting, the bone becomes decalcified, calcium salts being precipitated into the crushed muscles causing a metaplastic bone formation Pochhammer and Schuennow also state that calcium deposits are common in fresh laparotomy wounds, but disappear early Gruber believes therefore that the local deposits of calcium have no influence in parosteal bone function The "dystrophic bone" is a process different from myositis ossificans It requires a much longer period of time up to several months or even years and follows to a necrosis of tissues In no case of myositis ossificans calcium deposits were found Also Rode restudying recently the rôle of calcium salts to bone formation in muscle, concluded that calcium locally given has no influence to metaplasia of normal connective tissue

Mebius, Gruber, Dibellet and also Christophe suppose, that an increased amount of calcium salts in blood serum plays an important rôle in the appearance of metaplasia In my two cases among the three examined, the calcium salts content of blood was markedly increased They are submitted to the intern secretion of parathyroid corpuscles With an increase of their function the calcium salts content of blood rises (Jerome Reuss) It rises also if through some cause skeleton bone atrophies If the elimination of calcium by the kidneys is abnormally limited, the salts become deposited in soft parts It may be that they acting upon the central nervous system, and on the other hand upon the neuromuscular apparatus, cause a tendency to bony metaplasia of the damaged and inflamed tissues

Among many other factors suggested to cause a metaplasia is to mention the synovia Eden, stating that the most privileged regions to development of myositis ossificans are those near joints and the joint capsule was often grown together with the mass, attributed a very significant rôle to the synovia Pau, Schwenck, Frangenheim, Grashov, Nowakowski have seen ossification of joint capsule Some authors have found within the ossified mass a cyst filled with a synovia-like fluid In cases of Schwenck, Ludloff, Levy, a communication between such a cyst and a joint cavity was evident Ewald summing up his anatomical studies was able to record, that every one of the joints being in question has special muscles or muscle

bundles straining the joint capsule. He favored the assumption of Eiden that the named muscles convert into bone when injured under influence of synovia fluid escaping from an opened joint capsule or that the synovia itself may be organized and ossify. Ewald, however, was not able to prove his theory experimentally.

Beindt is of opinion that to slight hæmatogenous infection is due the development of parosteal bone formation because in some cases, operated upon, there was slight rise in temperature. In the initial course in some instances there were marked inflammatory symptoms (Salmann, Peiser, Itzerot) or ossification followed upon metastatic abscesses or phlegmon (Roskowski, De Witt, Noble). Dor found in a parosteal mass a microorganism, which injected, occasioned a periostitis albuminosa or a suppurating osteitis with hyperostitis and exostosis formation. Lewis also believes some cases of myositis to be undoubtedly secondary to some infectious process in the muscle. I have the impression that in my Case XV the changes were due to a microorganism similar to those of a chronic osteomyelitis. Case XVI is also undoubtedly of infectious origin. Seydeler quoted by Carey, Haga and Fujimura, held that hemorrhagic blood may organize and transform into cartilage and bone. After Holzknacht myositis is a physiologic reparative process agreeing to Wolff's transformations law that connective tissue tends to strengthen the static apparatus, if it be damaged somewhat.

Schuhardt and Rathke explain the genesis of myositis ossificans by means of the histomechanic theory of Roux. In every place, where the tissues are submitted to pulling and rubbing arise cartilage cells. They transform into bone by want of rubbing. Le Cleic attributes great importance to uric acid diathesis. The next factors assumed to cause a metaplasia are trophic or sensitive changes (Eichhoist, Klemm, Wilms and many others). The theory is based on the appearance of parosteal bone following some spinal troubles, as syringomyelia, tabes, myelitis, paraplegia, Little's disease and others, after lesions of motor centres exclusively, myositis ossificans was, as far as I could find, not observed. The adherents of periosteal theory believe the sensitive disturbances are of greatest importance. Ataxis, muscle hypotonia and sensitive disturbances are due to uncoordinated muscle contractions and excessive movement, giving occasion enough to stripping of periosteum (Morgenthal, Assmann). Accordingly it may be said that generally the articular changes are a later appearance than myositis. With syringomyelia there is no ataxia or muscle hypotonia.

Neurotrophic changes are held by others (Leyden, Goldscheider) as predominant factors causing a metaplasia. It may be that the want of checking influence of nerves plays an important role, the tissues lose their normal relation to each other.

According to Zanolli the main factors are intoxications and infections. The toxins act as irritants upon tissues, being in a state of less resistance. The decalcifications common in paraplegics, accompanied by circulatory disturbances, help to calcium salts deposits. But since also in presence of spinal

trouble myositis ossificans is relatively rare, there must be another cause, possibly congenital

The etiology of bone formation occurring in clean incised wounds of the abdomen wall is also an open question. Some believe that there also a periosteal stripping is possible. Others assume a sort of predisposition: the linea transversa are the remains of a rib and the white line a prolongation of the sternum. For this reason they contain sometimes osteogenic elements developing when injured, bone formation. Others assume a pure metaplasia on the basis of microscopical pictures, showing a marked transition of the connective tissue to bone with signs of inflammation (Mebius), under the influence of a hematoma (Vulpinus, Roepke), or effect of acid gastric secretion (Noble, Hering, Lewis), or acid urine (Lewis), for in most instances a myositis ossificans in the abdominal wall developed after operations on the stomach. Concerningly it must be stated that during the performance of a stomach resection or a gastro-enterostomy, gastric juice has no opportunity to come in contact with the abdominal wall. Most of the wounds healed rapidly. Also performing other experiments, I have injected many hundred times acid-pepsine solutions into the scar and normal tissues of several regions of the body of man and dog and have never seen a trace of bone formation.

In Case XVII an injury of periosteum, as well as contact with gastric juice, can be excluded. The wound healed by primary intention. Only a tendency of the region to transform into bone with addition of trauma of operation may explain its appearance.

Among other explanations may be mentioned the combined periosteal and metaplastic theory of Frangenheim, Koenig, and others. According to it parosteal bone arises from both tissues, from periosteum as well as from connective tissue. Busse and Blecher assume that both species of tissues work separately: the main mass appears within muscles and then grows together with the mass formed by periosteum, contrary to Berndt and Virchow, who are of opinion that the continuity between misplaced intra-muscular bone and the skeleton dissolve secondarily. The confirmation of this theory should be, according to Berndt, recurrences connected with the shaft, following often early operations of myositis. There is however, to add that recurrences followed chiefly when the primary mass was connected with the shaft by a bony pedicle and not when lying free within muscles. The recurrence may arise from periosteum being inflamed in a region near the primary inflammatory focus. On the other hand, the experimental studies of some writers, the school of Lexer especially, have found connective tissue is antagonistic to the periosteum: fracture does not heal, when connective tissue has grown between the fracture ends. Last it may be mentioned, that myositis, as a rule, develops mostly in the upper and lower third of the femur and the lower end of humerus, regions often a seat of exuberant callus formation after fractures and of neoplastic fracture complications (Frangen-

heim, my Fig 16) We never meet with in bones lying superficially as for example the tibia (Frangenheim)

Some authors (Weiner, Frank, Berndt, Lewis) assume for several cases several geneses

Any explanation must be more or less hypothetic until it has become possible to produce these parosteal bones experimentally and constantly, says Fay, quoted by Bowen It has proved, however, unsuccessful up to date, omitting some single observations of some authors (Berthier, Barth, Gruber, Haga and Fujimura), though much experimental work has been done upon this subject

Marchand and Coton have used synthetic bone, Eden calcium salts intramuscularly without effect Barth, Morpurgo, Baschkirzew, Petrow and Pochhammer implanted bone ashes, and Sultan, A\hausen, Baschkirzew, Petrow, Regard a boiled bone without success Cristophe, however, transplanting in alcohol fixed bone, believes that by way of metaplasia of connective tissue it may become a living bone To the same conclusion came Ely Gruber could state no influence of calcium salts to bone formation within muscle

Rohde made extensive experimental studies upon metaplasia and favors the assumption that we are dealing with undifferentiated cells, having a tendency to transform A well-developed connective tissue is not able to convert into bone, even under the influence of calcium salts, either boiled or dead unboiled bone He says, one never meets with a parosteal bone formation in the neighborhood of pathologic destruction of a living bone

Lever is of the opinion that metaplasia may develop in any part of the human body under the influence of an injury or an inflammation accompanied by increased amount of calcium salts within the blood The last cause however, is unknown The inclination of different parts to ossify is variable A subperiosteal hæmatoma may be followed by a scar formation, when an epidural by bone In tendon sheaths a hæmatoma ends with a scar and a hæmarthros may cause a fibrous or bony ankylosis for synovia membrane has near relationship to periosteum Intra-articular fractures heal often by a bony ankylosis

Hoffmann believes that connective tissue can transform into bone and fibroblasts can become osteoblasts

Bancroft, studying bone repair advances also the theory that "the so-called osteoblasts have very little to do with bone production Calcium salts are deposited in the extracellular elements of connective tissue The fibroblast then becomes a bone cell Undoubtedly the periosteum with its areolar tissue and numerous small blood-vessels is the best structure for bone formation but is not the only one"

Partsch found in some cases evident callus formation in connective tissue

Aschoff attributes a great significance to the reticulo-endothelial apparatus in metaplastic bone formation

## MYOSITIS OSSIFICANS CIRCUMSCRIPTA

To form my own judgment upon this subject, I performed thirty experiments on dogs, young and adult

1 In the first series I have transplanted grafts of periosteum, free or pedunculated, between the muscles, sound or crushed with a knife, or a forceps, with addition of a hematoma or coagulated blood clot

2 In the second series the same experiments repeated with administration of calcium salts by mouth, intravenously, subcutaneously or close to the transplanted periosteum or crushed muscle with or without addition of a hemorrhage

3 In the third series a joint fistula of a knee-joint was made to a periosteal flap, free or pedunculated, or to a crushed muscle, with or without calcium administration by ways as above. The muscles near to the fistula were healthy or crushed, with or without hemorrhage or blood clot addition

4 In the fourth series parathyroid corpuscles from a young dog were implanted between the muscles, calcium salts being administered subcutaneously at the same time and a pedunculated periosteal graft was implanted into the crushed muscles, or the muscle substance or their insertion to bone was crushed

5 In the fifth series in one dog the femoralis and obturatorius nerves were cut and then a periosteal flap with muscle attachment on the anterior surface of the lower end of the femur was embedded in the rectus muscle crushed with forceps and a joint fistula was made to the crushed muscle. In another dog showing a paresis of the both hind legs a joint fistula was made to a crushed muscle, to a pedunculated periosteal flap and to a crushed muscle attachment

*Technic*—Periosteum was torn off in every instance with a sharp instrument (raspatorium). Muscles were crushed with a forceps or a knife. Fresh blood clots were used from the same animal. That the joint remained open for a time (three weeks) was proved by cyst formation in the damaged soft parts. Intravenously calcium chloride solution, 10 per cent, was used every other day, three weeks long. Subcutaneously calcium phosphoric suspension was given for the same period of time. The parathyroid corpuscles were taken from dogs of equal weight and age (four months). The dogs were not kept in a cage, but ran freely in a room. The dogs were then examined every third week by X-ray by palpation in a number of experiments by exploratory incision and then all by necropsy. The observation time lasted from three weeks to four and a half months.

*Results*—The results obtained are as follows. Free transplanted periosteum grafts formed bone in no instance. In no case also did any bony mass develop within muscles being crushed, or at their damaged insertion to the periosteum, pedunculated periosteal grafts formed only a small exostosis at the basis of their pedicle. A periosteal transplant with a plate of cortex showed extensive growth in no instance, neither transplanted free nor with muscle attachment. The transplanted plate disappeared within some weeks.

These experiments do not explain whether the periosteal bone may descend from periosteum or from connective tissue. But if any conclusion can be formed from experiments on animals to that of man, I must conclude, that the foregoing experiments failed totally to confirm the theories, referring to genesis of myositis ossificans illustrated by the above experiments. They seem to suggest that all the factors assumed as playing a rôle in periosteal bone development as a hematoma, synovia, calcium salts, nerve disturbances, in presence of periosteal stripping or muscle crushing, are not able to produce it alone or combined. Assumption of an additional, maybe, congenital factor, seems to me unavoidable.



The want of success in these experimental studies and the difficulty of explaining all cases of myositis ossificans by any of the theories has caused most investigators to come to the opinion, there must be a congenital factor in it. According to the constitutional theory, called by Virchow, Koester, Recklinghausen and others, a diathesis ossificans, there is a particular congenital tendency of some particular regions of body to react to injury with metaplasia of connective tissue to bone. The connective tissue, stopped at some point of incomplete differentiation, tending under some conditions to proceed to later stages of the development (Van Der Briele, Rhode, Stempel, Cahen, Bard and others), or young connective tissue has the ability to assume the character of an embryonic tissue with its normal course of changes (Graf, Vulpius, Schmidt). An easy vulnerability of bony system and inclination to produce (Pinkus). Here belongs also the theory of aberrant sesamoid bones of Bard, Painter, Marshall, Ziegler, Bowen, Binne, Knaak, De Witt, Villaret, Heim and others, authors of last date, who imagined the genesis of myositis ossificans to be as follows:

There is a congenital dyscrasia or diathesis of various degree. Individuals in the first group have the greatest tendency to bony transformation and develop the progressive type of the disease early in life. The other group inclines to form circumscribed bony masses after repeated slight injuries, while those in the third group with a less dominant diathesis require a very severe trauma to produce bone in muscle.

Painter believes that this is the only pathogenetic theory which will cover all cases.

Some facts, as several times reported, cases of parosteal callus formation developing multiple, either soon after a single severe injury (Busse and Blecher, Berndt, Carey) or within a longer period of time after another severe injury in the same or other region, or after repeated slight injuries multiple (by Knaak between 28 rider bones there were 6 bilateral), favor considerably the theory of congenital tendency to parosteal ossification. A certain number of such cases was observed by Schultz, Haga and Fujimura, Busse and Blecher, Cordijot, Katz, Delorme, Siem, Koester, Labrevoit, Eichhorst, Wilms, Schlesinger and others. The most of them were, however, accompanied by changes of the medulla spinalis.

The congenital theory does, however, not explain the regularity of parosteal bone formation after posterior dislocation of the elbow. Possibly in these there act different factors. At first the periosteal stripping or a local tendency to ossification of the region in question.

The relative rarity of development of myositis ossificans in young individuals speaks also against the theory of Painter.

*Pathological Classification*—The opinion of authors vary considerably regarding the nature of myositis ossificans. Some of them, as Cahen, Van Der Briele, Ziegler, Honsell, believe, referring to its traumatic origin, to the irregular mixture of tissues in its composition its uselessness for the organism, that it is a neoplasm, though instead of characteristic properties

of a tumor, namely limitless growths, myositis ossificans has the tendency to shrink

On the other hand Berndt, Borchardt, Haga and Fujimura, Delbet, Pels-Nelson and others, assume an inflammatory reconstructive process on the ground of the microscopical picture, which showed in several instances marked inflammatory signs of its clinical symptoms, including in the very beginning those of a local inflammation, swelling, tenderness, impairment of motion, of its tendency to diminish or to grow worse if early moved. Connective tissue and, especially, young granulations tissue, ossify, the inflammation prepares the ossification (Meibius)

The last group of writers are of opinion, that myositis ossificans takes a middle place between an inflammatory process and a neoplasm, (Virchow, Wolter, Helferich, Lexer, Salmann, Bremig), or that it is a sui generis disease of muscle. I believe we are dealing here with a reparative process, originated by an inflammation in the connective tissue.

*Discussion*—My cases regarding the etiology could be divided into certain groups. In Cases II, III, VI, VII, IX, and in some degree XIV, periosteal bone formations occurred in consequence to a single, more or less severe, injury. The traumatic symptoms were in all approximately identical. In Cases II, VI, VII, the lump was apparently attached to the shaft and its derivation from periosteum is probable. Such cases may be called periostitis ossificans as distinguished by some authors (Bloodgood). There is no ossification of a detached periosteal flap, but an inflammatory proliferative process on the periosteum of the shaft itself or of the perperiosteal tissues.

In Case III injury of periosteum is improbable. The new-formed bone lying in the quadriceps tendon was separated from the shaft of femur by the subquadriceps bursa, the last or the tendon tissue being likely the source of ossification.

In Case IX an injury to the periosteum is possible. There were apparent inflammatory symptoms at the olecranon. It is difficult, however, to explain the mechanism of displacement of avulsed parts of periosteum, as the triceps tendon is a very strong and compact one and an injury causes easier a fracture of olecranon than a tendon tear. There seems to be a bony metaplasia of soft parts near the inflamed skeletal bone.

Also Case XIV offers no argument for assumption of periosteal origin of bone formation within the coracoacromial ligament. As stated by Lexer's school, there is an antagonism between the periosteal bone formation and healthy connective tissue. A periosteal bone formation could in no way replace a ligament in a manner, leaving its shape regular and even and apparently homogeneous. The ossification is probably due to the elements of the ligament itself. This case belongs therefore to the group 3.

2. The traumatic cases after backward dislocation of elbow are probably genetically different from those mentioned above. They form a very common or even usual complication of this lesion. The periosteal stripping in this condition is an established fact. The assumption, therefore, that the adven-

tial bone descends from periosteum, is based on sound principles. The ossification begins, as evident in Case X, on the shaft of the humerus and the anterior aspect of the coronoid process, as also in other places near the bone. But there also the periosteum is not the only matrix of ossification for, as it can be seen in X-ray picture and microscopical sections, the joint capsule if injured is equally a seat of the process. The ossification seems to occur in the external layers of the membrane. But as the appearance in other joints is not a usual and steady one, one can conclude that the connective tissue neighboring to some joints and to the elbow-joint especially, and firstly the joint membrane, being maybe insufficiently differentiated, tends to transform into bone, when injured or inflamed. The traumatic inflammation is probably a factor of greatest importance. The cases suggest to have no other disposition to metaplasia than a local one.

3. The Cases I, IV, V, XIV, are the most remarkable. The parosteal bone appeared in consequence or parallel to a chronic joint disease. The joint symptoms in Case I were covered by those of the mass before removal of the last, but undoubtedly were existing as the primary condition. In this case a periosteal stripping, either from the femur or from the iliac bone, is very improbable. One could indeed imagine the fluid distending the joint capsule was able to tear it off at some point of its margin and with it a periosteal flap, being inflamed and consecutively more loose, but it is impossible to understand the detachment of a periosteal flap at its whole circumference and its displacement into the muscle. Still more improbable appears the descending of the plate from the iliac bone, though the mass was connected with it by a scar pedicle. The new bone was grown strongly with the joint capsule forming a sort of a stalactitic process directed downward. The impression is that the inflammation extended to the near tissues, causing their bony metaplasia. It is impossible to decide what has given a disposition to it, whether calcium salts or any other factor.

Similar to it in Cases IV, V, XIV, there is also a combination of chronic joint changes with an ossification in the neighborhood. All cases but one (IV) concern the old-aged individuals, suffering from deforming arthritic process. Ossification in old age is to some degree physiologic and a rather common appearance. It is also characteristic to deforming arthritis, that there are almost constantly deforming exostotic bone changes at the margins of joints (Struempel). Similar condition is given in Case I of Bowen, where there were also chronic joint changes at the knee and ossification occurred, though far from it, in an injured region. Excessive ossifications close to joint are also essential in the neurotic form of myositis ossificans. There could be two possibilities. Either the development of a deforming arthritis, even of a single joint, is based on a congenital or acquired tendency and the bone formation, near the diseased joint, is a consequence of inflammatory changes of the involved tissues, probably tending to ossification as a physiologic appearance of old age or under the influence of the product of inflammation, or the deforming arthritis as well as the tendency to ossify or to development of

## MYOSITIS OSSIFICANS CIRCUMSCRIPTA

exostosis are all together depending upon a diathesis without any relation to each other

Case IV requires a separate discussion. Ossification developed in a young girl in connection with a tuberculous arthritis. Such combinations were already reported sometimes *e g.*, by Kaufmann in consequence to a tuberculous spondylitis. There are but few arguments to assume a periosteal bone formation. More intercede for a metaplasia. This case would lead to similar conclusions as the cases above. The chronic joint changes are able to cause a metaplasia itself, although a part of the ossification could undoubtedly originate from periosteum.

4 Cases VIII, XV, belong to the so called myositis ossificans chronica. In Case VIII ossification developed within the biceps muscle of the arm. There is no ground to believe the mass originated from a periosteal flap as in Case XV, where ossifications occurred in a period of seven years, after comparatively slight injuries and disappeared spontaneously. In one instance only the inflammatory symptoms were very marked. After a time a bony sequestrum loosened itself and the process healed after treatment with an autovaccine. It would prove the changes were due to a microorganism similar to those of a chronic osteomyelitis. But even here an assumption of a congenital inclination seems unavoidable.

Case XVI gives a very rare condition of metaplastic bone development on a base of neoplastic process.

In Case XVII bone formation within a laparotomy scar, a lesion of periosteum, can be absolutely excluded.

In regard to the general tendency or dyscrasia it is very difficult to make a precise definition. Whether we are dealing with general appearance of an insufficient differentiation of cells descending from mesoblast in the whole organism or possibly in one part of it or the tendency is acquired and based only upon a disturbance within the calcium management, as a factor acting generally, possibly under the influence of inner secretory glands or but locally reducing the muscle or nerve sensibility or by way of trophic nerves, is difficult to say. This only one seems to be sure that the last cause is always the process of inflammation, the same whether due to a severe injury or a small hemorrhage or a luxation, whether raised by microorganisms or by an aseptic knife. From that standpoint any form of myositis ossificans could be considered as a traumatic one.

## CONCLUSIONS

1 The opinion, advanced by Machol, that not to a dislocation of the elbow itself, but to the reposition, is due to development of parosteal callus after dislocations is not right, as proved by the Cases X, XI.

2 The statement, that an ossification never occurs near a chronic destruction of a living bone, is annulled by the Cases I, IV, V, XIV. In four of sixteen cases, ossification developed in the neighborhood of a chronic diseased joint without any trauma preceding.

3 Parosteal bone formation, exostosis and chronic deforming joint changes occur often in the same individual, suggesting there must be a connection between them

4 Bone formation after backward dislocations of the elbow originate from periosteum as well as from joint capsule, probably with addition to a local disposition

5 Assumption of a special tendency, congenital or acquired, for the development of a metaplasia is unavoidable at present as well as for excessive callus formation

6 Myositis ossificans is a reparative process within the young connective tissue, originated by inflammation

7 All forms of parosteal bone are identical as regards the trauma given inflammation, regardless to what sort of irritation the last may follow

In conclusion I desire to express my hearty thanks to Prof Dr H Schramm for his advice and opportunity given me to accomplish my article

#### BIBLIOGRAPHY

- <sup>1</sup> Alipow Zentralorgan f Chirurgie, vol xxv, p 85, 1924
- <sup>2</sup> Assmann Klinische Roentgendiagnostics d 1 Krankheiten, 1924
- <sup>3</sup> Aschoff Pathologische Anatomie, 1911
- <sup>4</sup> Baucr Nordmann-Kuettner Die Chirurgie, 1925
- <sup>5</sup> Busse and Blecher D Z f Chir, vol lxxviii, p 388, 1904
- <sup>6</sup> Bull Zentralorgan f Chir, vol xxv, p 422, 1923
- <sup>7</sup> Bristow, W Rowley Zentralorgan f Chir, vol xxviii, p 171, 1923
- <sup>8</sup> Bowen Arch f Surg, vol ix, p 3 1924
- <sup>9</sup> Bancroft Surg, Gyn and Obst, vol xl, No 2, p 148, 1924
- <sup>10</sup> Baetzner Arch f Chir, vol cxviii, p 507
- <sup>11</sup> Begleiter Pol Tyg Lekarski, 1914
- <sup>12</sup> Bertolani del Rio Zentralorgan f Chir, vol xxv p 54 1924
- <sup>13</sup> Blencke Archiv f Chir, vol ciii p 763
- <sup>14</sup> Bode D Z f Chir, vol lxxviii p 546, 1905
- <sup>15</sup> Borchardt D Z f Chir, vol lxxviii, p 17, 1903
- <sup>16</sup> Berndt Arch f Chir, vol lxxv, 1906
- <sup>17</sup> Chaton and Caillods Zentralorgan f Chir vol xxii, p 423, 1923
- <sup>18</sup> Christophe Zentralorgan f Chir, vol xxii, p 257, 1923
- <sup>19</sup> Carey Arch of Surg, vol viii, No 2, 1924
- <sup>20</sup> Ely Arch of Surg, vol ix, No 1, 1924
- <sup>21</sup> Ewald D Z f Chir, vol cxvii, p 310
- <sup>22</sup> Fog Zentralorgan f Chir, vol xiii, p 428, 1921
- <sup>23</sup> Fog Zentralorgan f Chir, vol xi, p 329, 1921
- <sup>24</sup> Fay Zentralorgan f Chir, vol v, p 388
- <sup>25</sup> Frangenheim Arch f Chir, vol lxxv, p 445
- <sup>26</sup> Frangenheim Berl Klin Woch, 1908, vol xii, p 758
- <sup>27</sup> Frangenheim D Zeitschrift f Chir, vol xc, p 87
- <sup>28</sup> Gruber Mitteil a d Grenzgeb, vol xxvii, No 4, 1914
- <sup>29</sup> Geldmacher Zentralblatt f Chir, 1925, p 1134
- <sup>30</sup> Grune Arch f Chir, vol xciv, p 476
- <sup>31</sup> Gallagher J A M A, vol lxxxi, p 18, 1923
- <sup>32</sup> Grosskurth Berl Klin Woch, 1908, p 1905
- <sup>33</sup> Gruber Bruns Beitr, vol cvi, 1917
- <sup>34</sup> Gottstein Zentralblatt f Chir, 1911, p 1118

# MYOSITIS OSSIFICANS CIRCUMSCRIPTA

- <sup>1</sup>Heim Zentralorg vol xix, p 73 1922
- <sup>2</sup>Heim Arch f Orthop, vol xx, No 3, 1922
- <sup>3</sup>Haga and Fujimura Arch f Chir, vol lxxii, p 64
- <sup>4</sup>Hering Zentralblatt f Chir, 1925, p 13
- <sup>5</sup>Honsell Bruns Beitr vol xxii, p 277, 1898
- <sup>6</sup>Hoffmann Arch f Chir vol cxxxv, p 413, 1925
- <sup>7</sup>Israel Arch f Chir, vol cxviii p 507
- <sup>8</sup>Israel Zentralorgan f Chir, vol x, p 391
- <sup>9</sup>Janusz Personal Communication
- <sup>10</sup>Kaufmann Lehrbuch d Pat Anat 1922, p 1589
- <sup>11</sup>Koch Arch i Chir, vol cxxxv, p 38 1925
- <sup>12</sup>Koch Zentralblatt f Chir 1925 p 1150
- <sup>13</sup>Koenig Arch i Chir, vol lxxx, p 61
- <sup>14</sup>Karell Zentralorgan vol xxix
- <sup>15</sup>Klose Zentralblatt f Chir, 1911, p 1294
- <sup>16</sup>Lick Arch i Chir, vol lxxx p 279 1906
- <sup>17</sup>Lewis Dem J A M A vol lxxx, p 1281, 1923
- <sup>18</sup>Locht Zentralblatt i Chir, 1923 p 1487
- <sup>19</sup>Lever Die neuen Transplantationen N D Chir 1924
- <sup>20</sup>Marshall Zentralorgan f Chir vol xiii p 428, 1921
- <sup>21</sup>Makins Elmslie Bristow Surg Gyn and Obst vol xxxix, No 4
- <sup>22</sup>Mebius Virch Arch vol cxlviii pp 1-2 1924
- <sup>23</sup>Meyer-Gottlieb Experimentelle Pharmakologie 1922
- <sup>24</sup>Myers D Z f Chir, vol liv, p 207, 1899
- <sup>25</sup>Neri Zentralorgan i Chir, vol v, p 238 1914
- <sup>26</sup>Nutt J of Bone-joint Surg vol v, p 344 1923
- <sup>27</sup>Noble Surg, Gyn and Obst vol xxxix (vi), p 705 1924
- <sup>28</sup>Nowakowski Nowiny Lekarskie, 1913 p 380
- <sup>29</sup>Nadler D Z i Chir vol lxxiv p 427 1904
- <sup>30</sup>Partsch Zentralblatt i Chir 1925 p 1151
- <sup>31</sup>Paul Arch of Surg vol x p 185, 1925
- <sup>32</sup>Painter J A M A 1921 vol lxxvii (vi), N M
- <sup>33</sup>Painter Zentralorgan f Chir vol xiv p 290
- <sup>34</sup>Pochhammer Arch i Chir vol xciv (1)
- <sup>35</sup>Rehberg Zentralorgan vol xi p 520
- <sup>36</sup>Rohde Arch f Chir vol cxxviii p 302 1924
- <sup>37</sup>Rohde Arch f Chir vol cxxix p 435 1924
- <sup>38</sup>Rohde Zentralblatt f Chir 1925 p 1148
- <sup>39</sup>Rohde Zentralorgan i Chir vol xxix p 9 1925
- <sup>40</sup>Riess Arch i Chir vol cxxix p 750, 1925
- <sup>41</sup>Rocpke Arch i Chir vol lxxxii, p 81
- <sup>42</sup>Szencs Mitteil i d Grenzgeb d Chir vol xxxvi (ii) 1923
- <sup>43</sup>Schultze Mitteil a d Grenzgeb d Chir, vol xxxvi p 213 1923
- <sup>44</sup>Szerszynski Przegl chir-ginekol vol ix, p 68 1913
- <sup>45</sup>Strauss Arch f Chir, vol lxxviii p 111 1906
- <sup>46</sup>Strauss D Z f Chir, vol lxxxix p 630 1907
- <sup>47</sup>Sacco Zentralblatt i Chir, 1925 vol xiv
- <sup>48</sup>Sudcek D Z f Chir vol cl, p 105
- <sup>49</sup>Westmann Act Radiolog, vol iii, (1), 1924
- <sup>50</sup>Wiesenthal Zentralorgan f Chir, vol xxviii, p 120, 1925
- <sup>51</sup>Walzel Arch f Chir, vol cv
- <sup>52</sup>Wolter D Z f Chir, vol lxxiv, p 318, 1902
- <sup>53</sup>Zanoli Surg, Gyn and Obst, vol xxxix p 4

# GASTRIC RESECTION FOR PYLORIC AND DUODENAL ULCER

A PRELIMINARY REPORT

By R. FRANKLIN CARTER, M.D.  
of New York, N.Y.

Excision of the pylorus and the first part of the duodenum has not been accepted in all clinics as the method of choice in the treatment of patients with ulcer. However, the increasing frequency of excision for ulcer alone and the failure of other surgical measures in the cure of a relatively large number of patients, justifies a careful study of the method employed.

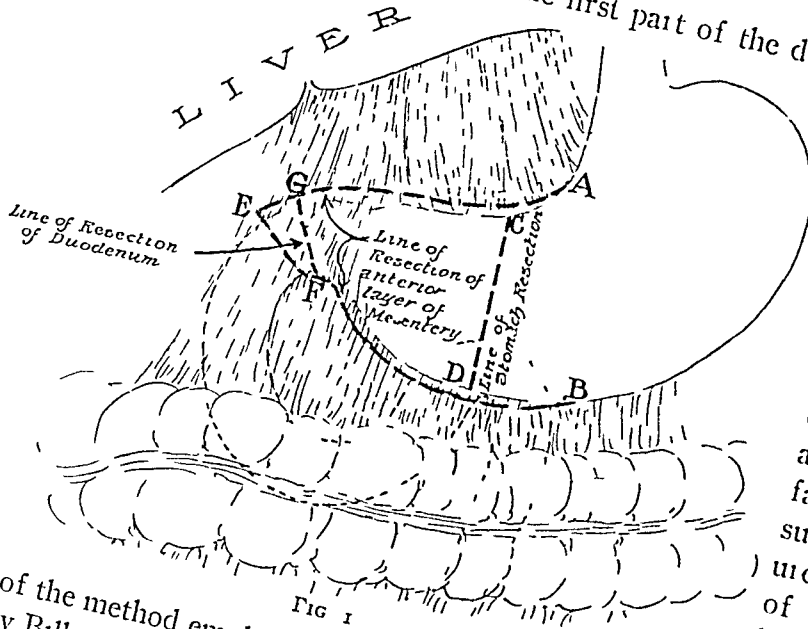


FIG 1

Since the first successful partial gastrectomy in 1881 by Billroth, the third reported up to that time, various procedures for the restoration of these parts have been suggested and employed. Because of the ruling factor, carcinoma and its dissemination, the first successful excision, and in the main, those following have been planned and carried out with the chief intent, that of removal, and then restoration of function as near as possible. In the presence of carcinoma restoration of function in part, or in any fashion that would work, has seemed to be

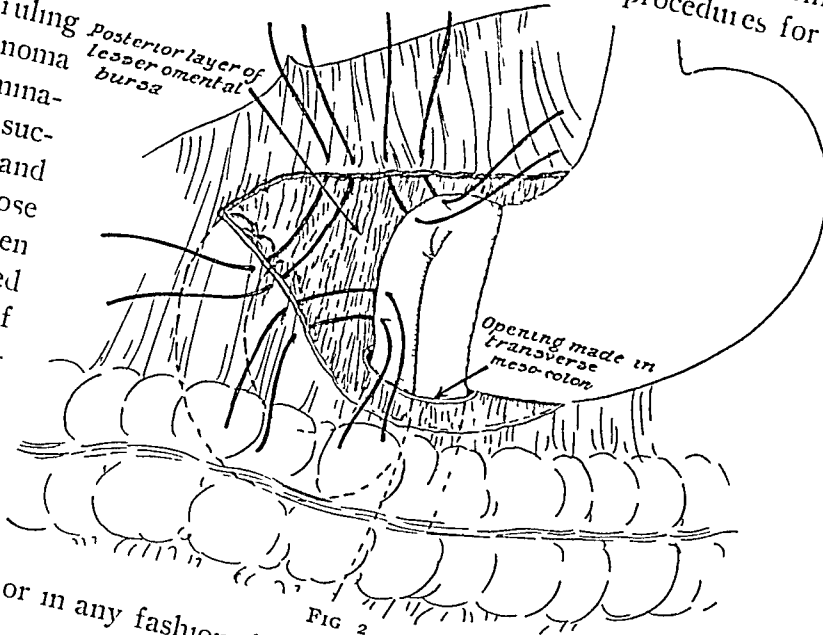


FIG 2

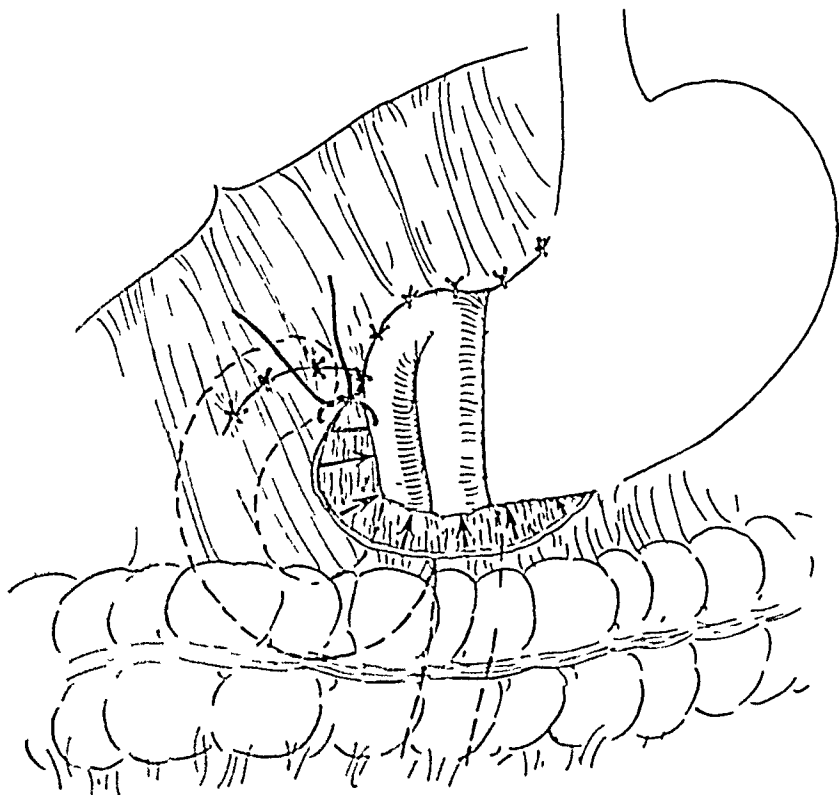


FIG 3

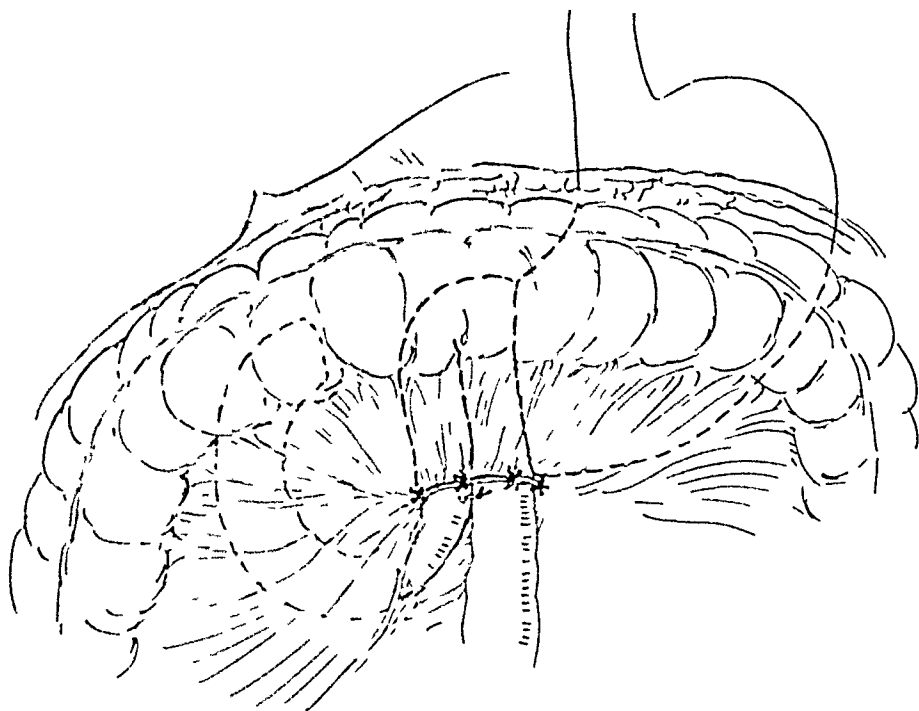


FIG 4



justified Any loss of physiological function of the stomach from the successful removal of a carcinoma will continue to be justified

In the case of ulcer, excision may be limited to the stomach and duodenum and less of that suffices The mesentery and that part of the stomach above

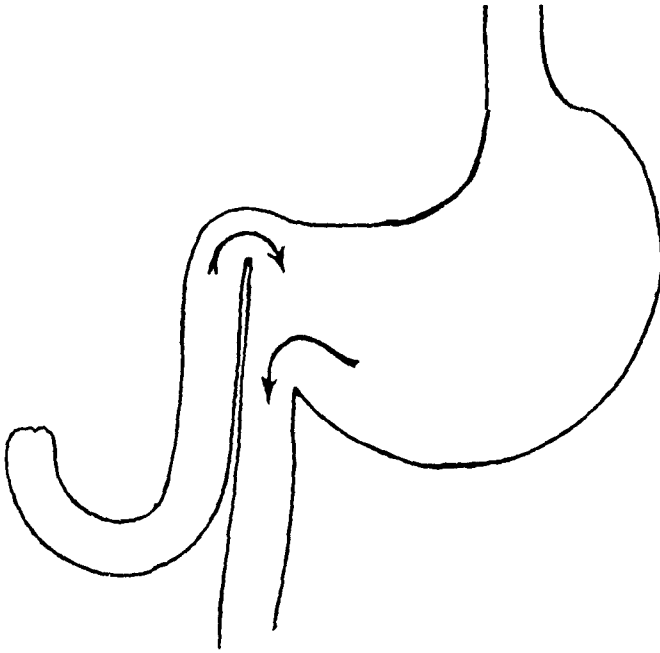


FIG 5

the line C-D (Fig 1) being useful and not involved in the disease should be kept and made to serve in the preservation and restoration of function in these organs

Maintaining the physiologic function of the stomach and restoring the mechanical action of the organs involved is a more important consideration in ulcer than in carcinoma The surgical treatment of ulcer of stomach and duodenum has been grafted on the surgical treatment of carcinoma of the stomach

rather than developed to meet the needs of the patient with ulcer Because of this the operation herein outlined is offered and in that it meets the anatomical requirements of

- 1 Excision of the ulcer-bearing area
- 2 Maintenance of physiologic activity of the stomach, in so far as possible
- 3 Restoration of anatomical function of stomach
- 4 Insures a thorough admixture with alkalization of the stomach content
- 5 Leaves no opening in either the anterior or posterior walls of the lesser omental bursa

The steps of the proposed method are as follows

Figure 1—Incision through the anterior wall of the lesser sac on the line AE-FB, keeping close to the curvature of the stomach and duodenum and carrying this incision back far enough on stomach and duodenum to insure sufficient free portion of both to enable the closure and anastomosis to be made with ease

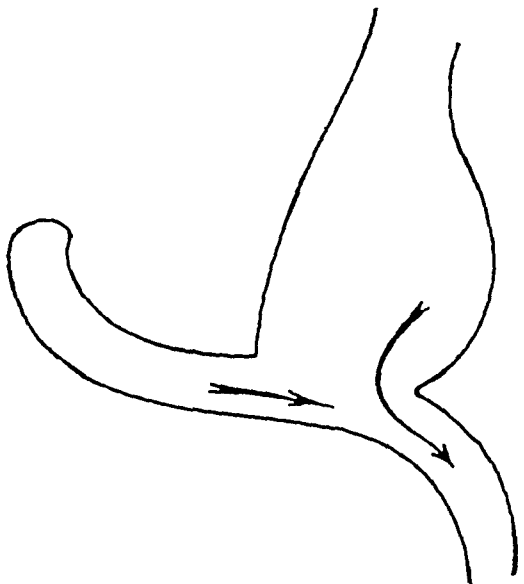


FIG 6

## GASTRIC RESECTION FOR PYLORIC AND DUODENAL ULCER

Figure 2 —Gastrojejunostomy by suturing the entire width of the stomach into the longitudinal opening in the distal half of the jejunal loop. Sutures placed in gastrohepatic and gastocolonic omentum.

Figure 3 —Closure of the anterior wall of the lesser sac by attachment of gastrohepatic omentum to the lesser curvature of the stomach and convex surface of the jejunum and gastocolonic omentum to the proximal and distal loop of the jejunum and greater curvature of stomach, thereby fixing the



FIG. 7

jejunum in this position and maintaining the normal anatomical position of the stomach.

Figure 4 —Suture of the margin of the opening made in the colonic mesentery about the proximal and distal loop of the passing jejunum, thereby fixing the jejunum and closing the opening in the posterior wall of the lesser sac.

Figure 5 is a drawing to represent the position of the stomach and the direction of the duodenal and stomach content when the jejunum is brought through the colonic mesentery and attached to the end of the pylorus.

Figure 6 is a drawing to represent the position of the stomach and the current of the duodenal content when the stomach is drawn through the colonic mesentery and sutured into the jejunum.

Figure 7—A skiagraph of the stomach in a patient two years following operation by this method. The stomach fills to normal capacity and empties in three and one-half hours. Peristaltic action of stomach maintained. Position of jejunum is that aimed at in the drawings. Peristaltic action of the

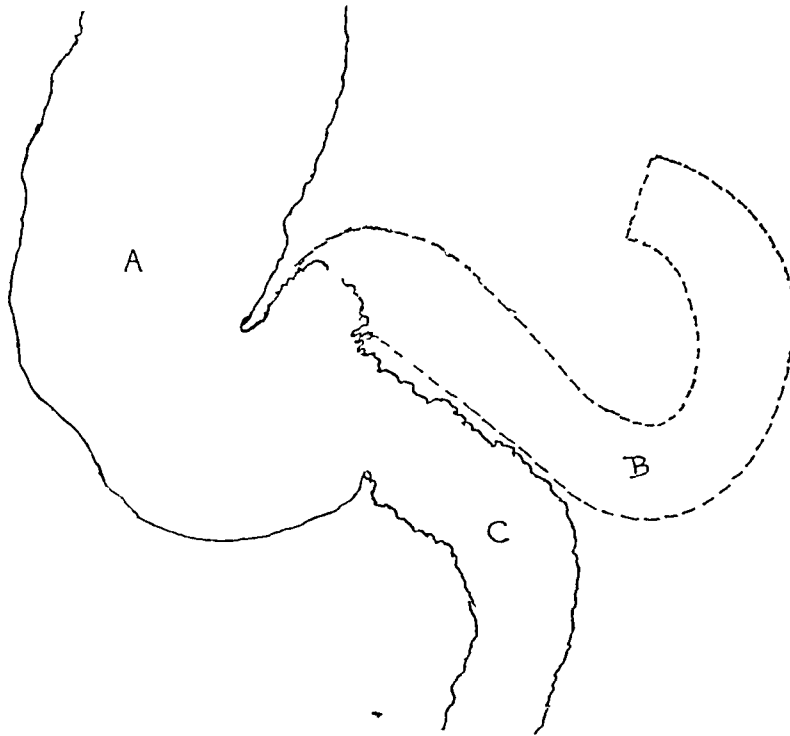


FIG 8

distal loop of the jejunum has not been interfered with by the longitudinal opening made for the anastomosis. There has been no dilatation of the distal loop, and there is no apparent back tracking of stomach content into the proximal loop of the jejunum.

Figure 8 represents diagrammatically the

anastomosis as it remains two years after operation. The stomach A and the distal loop of jejunum are traced from the X-ray Fig 7 with the proximal jejunum B, added to correspond in size and position with C as it shows in Figure 5.

# FAILURE OF GASTRO-ENTEROSTOMY TO EFFECT A DECISIVE REDUCTION IN GASTRIC ACIDITY

By RICHARD LEWISOHN, M.D.

AND

ROBERT H. FELDMAN, M.D.  
OF NEW YORK, N.Y.

FROM THE SURGICAL SERVICE OF DR. A. A. BERG, MOUNT SINAI HOSPITAL, NEW YORK

THE curative effect of gastro-enterostomy on pyloric and duodenal ulcers is usually ascribed to three substantial changes in the mechanics and chemistry of the stomach brought about by this operation, (1) the side-tracking of the food, (2) a marked reduction of the hyperacid stomach juice by the regurgitation of bile through the gastro-enterostomy stoma, and (3) the relief of pylorospasm with consequent healing of the ulcer. It is generally assumed that these three factors play a very important rôle in the healing of pyloric and duodenal ulcers. In fact, in most of the surgical text-books, published during the last thirty years these three points are mentioned as the causes for the cure of ulcers following gastro-enterostomy. Students are given the impression that these are not theories, but facts, and that the value of gastro-enterostomy as a side-tracking and acid-reducing operation has been established beyond doubt.

The medical and surgical profession have also accepted the correctness of these statements. Careful investigations, however, by different authors, have thrown serious doubt on the supposition that gastro-enterostomy side-tracks the food and thus favors healing of the ulcer, by putting the pylorus and duodenum at rest.

Kelling<sup>1</sup> established two intestinal fistulae on gastro-enterostomized dogs, one in the jejunum distal to the gastro-enterostomy and one in the duodenum. Most of the methylene-blue solution given to the dogs came out through the duodenal fistula, less than 10 per cent passed through the gastro-enterostomy.

Cannon,<sup>2</sup> who studied the function of gastro-enterostomy with the aid of roentgenography, came to the following conclusions: "The idea that gastro-enterostomy represents a drainage operation is wrong. There can be no doubt that in animal experiments the natural exit of the food is through the pylorus and not through the artificial opening, when both ways are offered for the passage of the food."

Lewisohn<sup>3</sup> demonstrated that after feeding thionin-blue to gastro-enterostomized dogs the stomach, the duodenum and the jejunum below the stoma show the same dark blue color. In other words, he demonstrated that in spite of the gastro-enterostomy a large part of the fluid passed through pylorus and duodenum. When pyloric exclusion according to Berg's method was added to the gastro-enterostomy, only a slight trace of thionin-blue was

---

\* Read before the New York Surgical Society, October 14, 1925.

found in the duodenum, whereas the jejunum showed the same dark green-bluish color, as in the first series of experiments

Many other authors have made similar observations which tend to show that in the presence of an open pylorus most of the food passes through the duodenum, in spite of the presence of a gastro-enterostomy

If we begin to peruse the literature on the second point, *ie*, the reduction of hyperacidity following gastro-enterostomy, we find practically uniform agreement among the authors that regurgitation of bile through the newly established stoma reduces the hyperacid gastric juice to a very marked degree. Innumerable papers have been written on this subject. They are practically in accord that gastro-enterostomy causes either a complete anacidity or a marked reduction of the acid figures

However, a few dissenting voices have been heard during the last few years. Conybeare<sup>1</sup> states that following a gastro-enterostomy most of the duodenal ulcer cases have a high acid figure

Wydler,<sup>2</sup> who examined gastro-enterostomized patients one to seven years after the operation, found a marked reduction of the acid values immediately after the operation. However, these reductions were not in evidence, when he examined the patients a number of years after the operation

Wilensky and Crohn<sup>3</sup> observed in 32 cases that the acidity is diminished following gastro-enterostomy, "though not to a considerable degree"

A recent study of the frequency of gastro-jejunal ulcers<sup>4</sup> afforded an opportunity of investigating, whether gastro-enterostomy reduces gastric hyperacidity. Eighty-eight patients operated upon between 1915 and 1920 were reexamined with the aid of an Ewald test-meal. Seventy-eight of these were men and 10 were women. The vast majority of these patients had an Ewald test-meal given to them before the operation and 11 had been reexamined before they left the hospital. Thus we were able by comparing these figures with those obtained after an interval of between three and eight years to get some definite data on acid figures following different methods of gastric operations, among them mainly partial gastrectomy and gastro-enterostomy with or without pyloric exclusion

It was impossible in covering this fairly large number to use the Rehfuess fractional test. This test is much more time-consuming, not only for the doctor, but for the patient. In fact, a goodly number of patients objected for various reasons (inconvenience, lack of time) to any form of gastric analysis. Some claimed that they were feeling well and did not want to undergo the annoyance of another test-meal. Thus about 20 per cent of the available cases could not be included in this series

Another reason for confining ourselves to the Ewald test-meal, in preference to the fractional test, was based on the fact that the Ewald test-meal had been used in the vast majority of patients before the operation. The best way, to acquire correct data for comparison, seemed to be to apply the same method which had been used before the operation

Furthermore, in 14 patients, in whom both an Ewald and a Rehfuess test-

# EFFECT OF GASTRO-ENTEROSTOMY ON GASTRIC ACIDITY

meal had been given before operation, we could observe that no marked difference between the figures obtained by these two methods was evident. The same observation was made in 6 out of these 14 patients, who had both Ewald and Rehfuess test-meals before and after operation. In other words, though slight differences in the figures are not unusual, no marked discrepancies in the acid curves were observed, no matter what method was used for the test-meal.

Private patients and a small number of patients operated upon on one of the other three surgical services were not included in this review. Their examination would have been connected with too many difficulties, as they are not observed in the follow-up system of this service.

It must be stated that the 88 patients comprise less than half of the number of patients operated upon on this service for gastric or duodenal ulcers between 1915-20. The total number of gastric operations for ulcer in the stomach or duodenum during this period amounted to 213 cases. As 22

TABLE I  
*Partial and Subtotal Gastrectomies for Gastric Ulcers*

Name	Year of operation	Acid figures before operation	Acid figures in 1923-24
1 B B	1918	1910 Gastro-enterostomy 1918 40-60 Partial gastrectomy for recurrent ulcer	0-20*
2 H D	1918	80-27	0-16
3 L N	1918	40-88	17-28
4 S K	1919	55-70	0-16
5 M B	1919	66-94	0-12
6 E K	1919	22-50	0-12
7 D W	1920	57-70	12-28
8 M S	1920	20-60	0-16
9 M R	1920	(Bleeding gastric ulcer)	0-25

\* 0-20 indicates free HCl 0, total acids 20

patients died following the operations, we could have reported on end results of gastric acidity in 191 patients, if we had been able to trace them and if all patients had been willing to submit to another test-meal.

Table I shows the acid figures from three to five years after partial or subtotal gastrectomy for gastric ulcers. None of these patients had a pre-operative anacidity. Three of them had a marked hyperacidity. Different authors have claimed that gastric ulcers are frequently connected with anacidity, whereas duodenal ulcers show marked hyperacidity. This observation is contrary to our experience, not only in the small number of 11 gastric ulcers presented in Tables I and II, but in a large series of gastric ulcers, operated on this service since 1920, cases which are not included in this series. In

fact, we have found that the vast majority of ulcers in the stomach show hyperacidity and that anacidity is a rare occurrence in the presence of a gastric ulcer

Table I shows that a marked reduction of the acid figures was observed in every case of partial or subtotal gastrectomy for gastric ulcer. In 7 out of 9 cases (77 per cent) a complete † permanent anacidity was obtained. In the other two cases the reduction was considerable (in one case from 57 to 12, in the other from 40 to 17). Absence of free HCl following operations on the stomach is to be considered a desirable sequel, for permanent anacidity practically guarantees a lasting cure to the patients. The anacidity produces no symptoms. We have observed a large number of patients over a period of many years and know that they are completely free from gastric symptoms after removal of one-half or even two-thirds of the stomach. Absence of free HCl practically safeguards against recurrence of ulcer, either in the stomach or duodenum, or at the site of the gastro-enterostomy stoma. Lorenz and Schui<sup>8</sup> pointed out some years ago, that, if antrum and pylorus are removed and the line of resection is kept 8–10 cm. from the pylorus, a marked hyperacidity is immediately changed into a complete anacidity. Partial or subtotal gastrectomy is the only gastric operation which is followed by an immediate and permanent anacidity in nearly 80 per cent of the cases and at the same time gives good functional results.

We have never observed a case of pernicious anæmia following partial or

TABLE II  
*Sleeve Resection for Gastric Ulcer*

Name	Year of operation	Acid figures before operation	Acid figures 1923–24
1 T R	1916	61–79	0–16
2 N B	1917	18–34	0–21
3 H S	1917		0–57

subtotal gastrectomy and our observations extend back over a period of twelve years.

Table II shows a small number of cases (3) in which sleeve resection for gastric ulcer was performed about nine years ago. The number is very small, as this operation was abandoned after a few trials in favor of partial gastrectomy. A permanent anacidity was obtained in these three cases. Thus the change of a hyperacid stomach contents into an anacid one was effected by this method. These ulcers were all situated midway between cardia and pylorus at the so-called reentrant angle. It is well known that this location is the place of predilection for the vast majority of ulcers of the lesser curvature. It is interesting to note that a permanent anacidity was obtained in these cases, in spite of the fact that pylorus and antrum were not removed.

† By complete anacidity we mean complete absence of free HCl.

# EFFECT OF GASTRO-ENTEROSTOMY ON GASTRIC ACIDITY

Lorenz and Schui<sup>8</sup> have pointed out that in order to establish a permanent anacidity, pylorus and antrum up to about 10 cm from the pylorus must be resected. However, the permanent anacidity obtained after a sleeve resection shows, that the same result can at times be obtained by removing a comparatively small sleeve at the recumbent angle without removal of antrum and pylorus. *The recumbent angle evidently plays an important rôle in the question of gastric acidity.* Berg thinks that this point contains some very important nerve centres which influence gastric secretion. Further experimental work along these lines may clear up this very important question which, up to date, has not been sufficiently studied.

Goecke<sup>9</sup> also observed that all sleeve resections were followed by anacidity, whereas Faulhaber and v Redwitz<sup>10</sup> found anacidity in only 50 per cent of their cases.

Our reason for discontinuing sleeve resection on this service, was that the functional motor results were very unsatisfactory. Two out

TABLE III  
*Pylorectomy for Pyloric Ulcer*

Name	Year of operation	Acid figures before operation	Acid figures 1923-24
1 J P	1917	64-102	42-70
2 S B	1920	79-90	40-45 1924 Subtotal gastrectomy for gastro-jejunal ulcer 1925 0-28

of three cases have hour-glass formation at present, with fairly marked symptoms of retention. They could be cured by a subtotal gastrectomy. If these patients had been submitted to a partial or subtotal gastrectomy at the time of the primary operation, the functional results would have been far superior to those obtained by sleeve resection. The same bad functional results were obtained in a series of private cases, operated by Doctor Berg, which are not included in this report. For this reason sleeve resection was abandoned on this service many years ago, in spite of the fact that others (Judd,<sup>11</sup> Downes,<sup>12</sup>) have had satisfactory results following this operation.

Our operative procedure should be governed by three points of view. It should remove the ulcer and the ulcer-bearing area, (2) it should guarantee a perfect functional result (large stoma, normal emptying time, etc), and (3) it ought to establish a permanent anacidity in order to prevent the recurrence of an ulcer. Though sleeve resection is followed by anacidity, apparently bad functional motor results make this method decidedly inferior to partial or subtotal gastrectomy.

Table III demonstrates acid figures in two cases of pylorectomy. Both cases showed a considerable amount of acidity, when reexamined six and three years after the operation. One of these patients (S B) developed a gastro-



jejunal ulcer. He was re-operated last year. A subtotal gastrectomy was performed. It is interesting to note that he has now a complete absence of free HCl. In other words, the more radical procedure effected, what simple pylorotomy failed to do, *i.e.*, the establishment of an anacidity. Gastro-jejunal ulcer following simple pylorotomy is not a rare occurrence. Three cases were observed in this hospital and reported in a previous paper.<sup>7</sup> Partial

TABLE IV  
*Excision of Ulcer with or without Gastro-enterostomy*

Name	Year of operation	Acid figures before operation	Acid figures in 1923-24
1 D F	1915 Excision gastric ulcer	60-90	10-52
2 J G	1917 Excision gastric ulcer. Secondary gastro enterostomy in 1922	0-14	23-32
3 S S	Excision gastric ulcer plus gastro enterostomy, 1917	35-60	49-72
4 D B	Excision gastric ulcer plus gastro-enterostomy, 1917	15-65	10-25
5 M J	Excision duodenal ulcer, gastro-enterostomy, plus pyloric exclusion, 1918		1920 68-88 1921 partial gastrectomy for recurrent duodenal ulcer 1923 0-10
6 S M	Excision duodenal ulcer, gastro-enterostomy plus pyloric exclusion	67-90	35-55
7 A S	Pyloric ulcer, excision plus gastro-enterostomy, 1919		55-72
8 A U	Excision gastric ulcer plus gastro-enterostomy, 1919		5-25
9 B D	Excision pyloric ulcer plus gastro-enterostomy, 1919		55-90
10 H G	Duodenal ulcer, excision plus gastro-enterostomy, 1919	67-110	7-80
11 D G	Duodenal ulcer, excision plus gastro-enterostomy, 1920	90-100	19-55 (before radical operation) 1922 subtotal gastrectomy for gastro-jejunal ulcer 1923 0-20

gastrectomy cannot be considered a more serious operation than pylorotomy. However, this more radical procedure safeguards the patients against the development of a subsequent gastro-jejunal ulcer. For this reason pylorotomy, even in small pyloric ulcers, has been abandoned on this service for a number of years and has been replaced by partial or subtotal gastrectomy. Since this method has been used as the method of choice in practically every case, gastro-jejunal ulcers, which used to be the "bête noire" in our stomach work, have not been observed by us.

## EFFECT OF GASTRO-ENTEROSTOMY ON GASTRIC ACIDITY

We have grouped in Table IV, 11 cases in which a local excision of the ulcer situated either in the stomach or in the duodenum was performed, with or without gastro-enterostomy. Operations performed in the attempt to remove the local lesion were the following

Location of ulcer	Method of operation	No. of cases
Gastric ulcer of the lesser curvature	Local excision	2
Gastric ulcer of the lesser curvature	Local excision and gastro-enterostomy	2
Pyloric ulcer	Local excision and gastro-enterostomy	2
Duodenal ulcer	Local excision and gastro-enterostomy	3
Duodenal ulcer	Local excision, gastro-enterostomy and pyloric exclusion	2

In two of our earlier cases of gastric ulcer a simple excision was performed. The functional results following this simple operative procedure were very unsatisfactory. In fact, one of these cases required a secondary gastro-enterostomy five years after the primary operation. For this reason local excision without gastro-enterostomy has not been used in gastric ulcers for many years. However, even local excision combined with gastro-enterostomy failed to give good results. As soon as partial or subtotal gastrectomy was used consistently in this group of cases, the functional results were perfect. It seems of importance to point out, that the radical procedure was introduced on this service only after many attempts to cure this group of patients by more conservative methods had failed.

A marked reduction in the figures for free HCl was obtained in Case 1 (gastric ulcer). Case 4 showed about the same acid figures when reexamined six years after the operation, as those obtained before the excision and gastro-enterostomy. Case 8 showed a low figure upon reexamination after four years. However, it is impossible to state whether this low figure represented a reduction of the pre-operative acidity, as no test-meal was taken before the operation. It is well known that some gastric ulcers have a low acidity, and it is possible that this patient had low acid figures, before he was operated upon.

Case 2 showed a marked rise in the figures. Before the first operation (local excision) he had absence of free HCl. Immediately after the operation the figures were 46-70. A secondary gastro-enterostomy was performed in 1922. When reexamined in 1923 his figures were 23-32.

Two patients (Nos 7 and 9) with pyloric ulcer, in whom the ulcer had been excised and a gastro-enterostomy had been performed, showed high acid figures five and four years after the operation. No pre-operative test-meals were available for comparison.

Among the five cases of duodenal ulcers treated with local excision and

gastro-enterostomy (three of these had a pyloric exclusion performed in addition to the gastro-enterostomy) Case 3 showed a rise in the acidity when reexamined after six years. Three cases (Nos 6, 10 and 11) showed a marked reduction in their acid figures, but not an anacidity. The last of these cases (No 11) developed a gastro-jejunal ulcer. He was subjected to a subtotal gastrectomy in 1923 and has now—in conformity with practically all partial or subtotal gastrectomies—absence of free HCl.

Case 5 had no pre-operative test-meal. The primary gastro-enterostomy with excision of a duodenal ulcer was performed in 1918. His acid figures in 1920 were 68–88. He was re-operated in 1921 for recurrent duodenal ulcer. A partial gastrectomy was performed. When reexamined in 1923 his acid figures were 0–20.

If we correlate these data we observe the following interesting facts. Conservative operations (excision of the ulcer with or without gastro-enterostomy) failed to effect a complete anacidity among 11 cases of gastric or duodenal ulcers. However, a complete absence of free HCl was established in two of these cases following a partial or subtotal gastrectomy, after they had developed recurrent ulcers. These two patients submitted to the radical operation after they had been chronic invalids for years. They are in perfect health since the last operation.

Though this paper does not deal with clinical end results it may be of interest to point out that 9 patients still have gastric symptoms. Local excision of ulcer with or without gastro-enterostomy is generally considered a very good surgical procedure. Only two out of the 11 patients are perfectly well (18 per cent). From this experience it is evident that although our series is small, this form of operation is by no means satisfactory as to end results.

Table V shows the acid figures in 13 cases after simple gastro-enterostomy for pyloric or duodenal ulcer. None of these cases had an absence of free HCl upon reexamination, except Case 9. This patient, however, had been subjected to a subtotal gastrectomy one year after the gastro-enterostomy on account of marked retention with vomiting. In all the other patients, with the exception of Case 12, free HCl was above 26. Only one case (No 5) had very high acid figures before operation (78–109). The pre-operative figures for free HCl in the other cases ranged between 36 and 62. It is safe to predict, that a permanent anacidity would have been established in these cases, if partial gastrectomy had been substituted for simple gastro-enterostomy. Three cases (Nos 7, 10 and 11) had a higher acidity upon reexamination than before the operation.

A perusal of 50 cases of gastro-enterostomy with pyloric exclusion (Berg's<sup>13</sup> method) for pyloric and duodenal ulcers shows the following results as to post-operative gastric acidity.

In 8 patients (11, 14, 15, 20, 21, 28, 38, 40) figures for free HCl were higher than they had been before the gastro-enterostomy. In 4 patients (12, 35, 42, 48) pre- and post-operative acidity were the same. In 28 patients

# EFFECT OF GASTRO-ENTEROSTOMY ON GASTRIC ACIDITY

(1, 2, 3, 4, 5, 7, 8, 9, 10, 13, 17, 18, 19, 22, 23, 25, 30, 33, 34, 37, 41, 43, 44, 45, 46, 47, 49, 50) the acid figures were reduced. However, the reduction of acidity was a moderate one in the vast majority of the cases. In spite of the fact that 17 among these 28 cases had a pre-operative figure for free HCl of 40 and more, only 7 cases (25 per cent) showed a very decided drop. As stated above, the immediate drop from high acid figures to 0 is the usual occurrence following partial or subtotal gastrectomy. On the other hand, these figures show that absence of free HCl is extremely

TABLE V  
*Gastro-enterostomies*

Name	Year of operation	Acid figures before operation	Acid figures 1923-24
1 A B	1917		45-88
2 I N	1917	45-75	41-62
3 M P	1917	40-60	35-44
4 H L	1917	53-75	29-52
5 H J	1917	78-109	39-56
6 M F	1918	55-91	28-37
7 A D	1918	20-44	48-62
8 N R	1919		26-51
9 M R	1919	55-88	1920 subtotal gastrectomy 1923 0-27
10 B G	1919	62-70	68-96
11 J G	1919	36-77	41-58
12 M K	1919	45-85	16-37

rare following gastro-enterostomy. Anacidity was established only twice in 47 cases.

Seven cases (24, 26, 27, 29, 31, 32, 36) had no test-meal before the operation. In 2 cases (16, 39) acid figures were not recorded after the operation. These 9 cases were, therefore, not available for comparison.

A secondary partial gastrectomy was performed for recurrent duodenal ulcer with profuse hemorrhages in Case 6. His acid figures before the primary operation were 40-60. No test-meal could be taken before the secondary operation on account of profuse gastric hemorrhages. Partial gastrectomy performed nine years after the primary operation, established an anacidity (0-20).

Thus among 69 cases of gastro-enterostomy (10 of these with local excision of the ulcer) complete anacidity was obtained in only two cases (less

TABLE VI  
*Gastro-enterostomies with Pyloric Exclusion*  
*(Berg's Method)*

Name	Year of operation	Acid figures before operation	Acid figures in 1923-24
1 F H	1915	52-95	20-40
2 M S	1915	51-64	23-33
3 M F	1915	32-62	16-22
4 B H	1915	20-40	0-21
5 M H	1915	60-90	26-56
6 S S	1915	40-60	1924 partial gastrectomy for bleeding duodenal ulcer 0-20
7 S P	1915	61-77	35-55 1924 partial gastrectomy for gastro-jejunal ulcer 1925 0-9
8 M K	1916	65-90	39-47
9 L B	1916	50-75	25-46
10 J R	1916	40-80	26-38
11 A R	1916	42-60	48-70
12 W R	1916	38-74	40-80
13 S F	1916	50-93	12-37
14 J K	1917	61-81	78-90
15 H B	1917	26-52	59-75, subtotal gastrectomy for gastro-jejunal ulcer, exitus
16 M C	1917	60-100	1924 partial gastrectomy for gastro-jejunal ulcer, cannot be traced
17 J K	1917	70-94	30-45
18 M S	1917	66-86	30-54
19 L K	1917	75-98	1922 excision gastro-jejunal ulcer, 1923 before radical op 34-49, 1923 subtotal gastrectomy for recurrent gastro-jejunal ulcers, 1925 0-12
20 B J	1917	20-38	25-52
21 M S	1917	29-55	35-50
22 B G	1917	56-83	12-29
23 H P	1917	66-108	32-41
24 A B	1917		40-57
25 S S	1917	50-75	38-66

## EFFECT OF GASTRO-ENTEROSTOMY ON GASTRIC ACIDITY

TABLE VI—(Continued)  
*Gastro-enterostomies with Pyloric Exclusion*  
*(Berg's Method)*

Name	Year of operation	Acid figures before operation	Acid figures in 1923-24
26 M S	1917		25-45
27 S W	1917		50-85
28 F K	1918	55-70	65-82 Has gastro-jejunal ulcer
29 S G	1918		48-80
30 B M	1918	90-120	38-76
31 J M	1918		61-79
32 H F	1918		48-59
33 J S	1918	60-80	35-55
34 B S	1918	70-90	35-60
35 C K	1918	40-70	40-70
36 L B	1918		37-54
37 L Z	1918	35-56	20-38
38 P T	1918	40-70	72-85
39 D H	1918	22-59	Re-operated, partial gastrectomy Exitus
40 J C	1918	36-57	51-72
41 H A	1918	55-80	20-37
42 B G	1918	50-70	50-80
43 A K	1918	70-90	21-39
44 R L	1919	40-64	33-60
45 R G	1919	40-52	5-16
46 J A	1919	55-87	41-64
47 M A	1919	55-87	0-18
48 A F	1919	33-56	30-50
49 M K	1920	85-100	40-61 Patient has gastro-jejunal ulcer
50 F F	1920	95-115	60-72

than 3 per cent ), whereas Table I showed absence of free HCl following partial or subtotal gastrectomy in 77 per cent of the cases

In Table VII are grouped those cases which required a secondary partial or subtotal gastrectomy for gastro-jejunal or recurrent duodenal ulcer. In one case (VI, 6) no test-meal could be taken before the secondary operation on account of very profuse hemorrhages. In one case (V, 9) no test-meal

TABLE VII

*Secondary Partial or Subtotal Gastrectomy for Gastro-jejunal or Recurrent Duodenal Ulcer*

No	Acidity before gastro enterostomy	Acid figures before radical operation	Partial or subtotal gastrectomy	Acid figures after radical operation
I, 1, B B	1910 gastro enterostomy for gastric ulcer	1918 40-60	1918 Partial gastrectomy for recurrent gastric ulcer	1923 0-20
III, 2, S B	79-90—1920 pylorotomy for pyloric ulcer	1923 40-45	1924 subtotal gastrectomy for gastro-jejunal ulcer	1925 0-28
IV, 5, M Z	1918 excision duodenal ulcer, gastro-enterostomy plus pyloric exclusion 1920 removal of button	1920 68-88	1921 partial gastrectomy for recurrent duodenal ulcer	1923 0-10
IV, 11, D G	90-100—1920 excision duodenal ulcer, gastro-enterostomy	1922 19-55	1922 subtotal gastrectomy for gastro-jejunal ulcer	1923 0-20
V, 9, M R	55-88—1919, gastro-enterostomy for cicatrized pyloric ulcer		1920 subtotal gastrectomy for retention	1923 0-27
VI, 6, S S	40-60—1915 gastro enterostomy plus pyloric exclusion for duodenal ulcer		1924 partial gastrectomy for recurrent bleeding duodenal ulcer	1924 0-20
VI, 7, S P	61-77—1915 gastro enterostomy plus pyloric exclusion for pyloric ulcer Acidity before 2nd operation 46-55, 1919 excision gastro-jejunal ulcer	1924 22-40	1924 partial gastrectomy for gastro-jejunal ulcer	1925 0-9
VI, 19, L K	1916 gastro-enterostomy for duodenal ulcer, 1922 excision gastro-jejunal ulcer	1923 34-49	1923 subtotal gastrectomy for recurrent gastro-jejunal ulcer	1925 0-12

was taken before the secondary operation. In the other 6 cases free HCl varying between 19 and 68 was recorded. In all these 8 cases complete anacidity followed the partial or subtotal gastrectomy. In other words, what gastro-enterostomy had failed to do, was established following the more radical procedure in 100 per cent of the cases recorded in Table VII.

The question of anacidity following a gastric operation is by no means of academic interest only. It is a distinctly practical question of great importance. Partial or subtotal gastrectomy for gastric ulcer, no matter whether the ulcer was large or small, has been performed for many years on this

service, as well as in a number of other clinics. The results were uniformly good, after the proper technic had been established.

Habeier<sup>14</sup> applied the same principle (*i e*, partial or subtotal gastrectomy) to the surgical treatment of duodenal ulcers. He had encountered many failures (recurrent ulcers, gastro-jejunal ulcers, etc.) following gastro-enterostomy with or without exclusion, whereas his results in gastric ulcers following partial gastrectomy had been uniformly good. He then applied the more radical principle to the surgical treatment of duodenal ulcers. His results since then, covering a period of about five years, have been very excellent. The distressing picture of the patient, who was often in worse condition after the gastro-enterostomy than before he entered the hospital, was banished from his service.

Habeier did his excellent work on a purely empirical basis. Lorenz and Schui<sup>8</sup> showed that the reason for the absence of recurrent ulcers following partial or subtotal gastrectomy seems to be the establishment of a permanent anacidity.

It is a well-known fact that gastro-jejunal ulcers practically never occur in an anacid stomach. In a statistical study of the frequency of gastro-jejunal ulcers,<sup>7</sup> 18 per cent of the cases required re-operation for gastro-jejunal ulcer. Another 16 per cent had the clinical signs and X-ray findings of a new ulceration at the site of the stoma. When 34 per cent of a given series are suffering from this very serious complication, the question of how to avoid their occurrence becomes one of prime importance.

In spite of the fact that so many gastro-jejunal ulcers occurred on this service, this complication was never observed in an anacid stomach. We know very little about causation of ulcers. But we seem to have one safe way of preventing a recurrent ulcer or a subsequent gastro-jejunal ulcer, *i e*, the establishment of a permanent anacidity by partial or subtotal gastrectomy.

We have never claimed that gastro-enterostomy is a failure in every case. In fact, 50 per cent of the cases in the series quoted above<sup>7</sup> seem to be permanently cured. However, an operation should offer more to a prospective patient than one chance in two of being cured. In looking over the gastro-enterostomies recorded above we find that less than 3 per cent were anacid, whereas 77 per cent among the partial or subtotal gastrectomies performed during the same period had an anacidity. Therefore, we agree with Lorenz and Schui<sup>8</sup> that the establishment of anacidity is a very important factor in the selection of our operative procedure. Partial gastrectomy and sleeve resection seem to be the only two methods at our disposal which establish a permanent anacidity. Sleeve resection, however, should not be used on account of the bad functional motor results. Thus partial or subtotal gastrectomy seems the method of choice, if we want to safeguard our patients against recurrences.

Sherrin,<sup>15</sup> in a recent article, states that he is a "whole-hearted believer in the chemical action of gastro-enterostomy, as opposed to the purely mechanical. If the post-operative test-meal showed little or no reduction of



acidity, although the stomach may be emptying rapidly through the new opening, the patient may have further digestive trouble" Among 285 cases of chronic duodenal ulcers, in which gastro-enterostomy with or without excision of the ulcer was performed, 131 were anacid

Sherien's figures of 45 per cent anacidity contrast strongly with our figures which show 3 per cent anacidity for the same group of cases. We hope that other clinics will investigate their material along the same lines in order to settle this point definitely

How can we explain that a number of cases are permanently cured after gastro-enterostomy? If side-tracking of the food does not occur and if, as we have shown above, no marked change in the chemistry of the gastric juice takes place following gastro-enterostomy, what is the reason that 50 per cent of our cases operated between 1915 and 1920 are perfectly well? It is impossible to make any definite statements in explanation of this observation. However, it is very probable that in a certain percentage of the cases the pylorospasm is relieved following the gastro-enterostomy and that with subsiding inflammation the ulcer heals secondarily

It is our firm belief that the enthusiasm for gastro-enterostomy will wane during the next few years and that in ten years from now gastro-enterostomy will be used for the treatment of pyloric and duodenal ulcers as a makeshift operation, not as the method of choice. The clinical results following the more radical procedures are so infinitely superior in every respect, that the surgical profession will gradually adopt this method as the only procedure which seems to guarantee a permanent cure to a patient suffering from gastric or duodenal ulcer

#### CONCLUSIONS

(1) Complete anacidity (absence of free HCl) was observed in 77 per cent of the cases of gastric ulcer treated by partial or subtotal gastrectomy between 1915 and 1920

(2) During the same period complete anacidity was observed in less than 3 per cent of the cases treated by gastro-enterostomy with or without excision of the ulcer

(3) Pylorectomy does not effect an anacidity and is followed by gastro-jejunal ulcers in a considerable number of cases

(4) Complete anacidity was established in 8 cases requiring partial or subtotal gastrectomy for gastro-jejunal or recurrent duodenal ulcer. These patients had suffered for years following the primary gastro-enterostomy. They are perfectly well since the radical operation

(5) In order to prevent the occurrence of gastro-jejunal ulcers the primary operation ought to establish a permanent anacidity

(6) Partial or subtotal gastrectomy is the only method of operation which establishes permanent anacidity in a large percentage of the cases

(7) Partial or subtotal gastrectomy should be the method of choice in the surgical treatment of gastric and duodenal ulcers

# EFFECT OF GASTRO-ENTEROSTOMY ON GASTRIC ACIDITY

## BIBLIOGRAPHY

- <sup>1</sup> Kelling Studien zur Chirurgie des Magens Arch f Klin Chir, 1900, vol lxi, p 1
- <sup>2</sup> Cannon Mechanical Factors of Digestion, London, 1911
- <sup>3</sup> Lewisohn The Value of Pyloric Exclusion in the Treatment of Pyloric and Duodenal Ulcers Am Surg, 1918, vol lvi, p 561
- <sup>4</sup> Conybeare Late Results of Operation in Cases of Gastric and Duodenal Ulcers Guy's Hospital Reports, 1922, vol lxxii, p 175
- <sup>5</sup> Wydler Ein Beitrage zur Chirurgie des Magen- u Duodenal-Geschwuers Mittel Grenzgeb Med u Chir, 1922, vol xxxv, p 103
- <sup>6</sup> Wilensky and Crohn Studies in the Phys and Pathol of the Stomach Am J Med Sc, 1917, vol clm, p 808
- <sup>7</sup> Lewisohn The Frequency of Gastro-jejunal Ulcers Surg, Gyn and Obst, 1925, vol xl, p 70
- <sup>8</sup> Lorenz and Schur Unsere Erfahrungen ueber den Wert der Antrum-resektion bei der Behandlung des Ulcus pepticum Arch f Klin Chir, 1922, vol cxix, p 239
- <sup>9</sup> Goecke Beitrage zur Morphologie des Magens nach Resektionen Bruns Beitr zur Klin Chir, 1916, vol xcix, p 294
- <sup>10</sup> Faulhaber and v Redwitz Zur Klinik u Behandlung des pylorus-fernen Ulcus ventriculi Grenzgeb d Med u Chir, 1914, vol xxviii, p 150
- <sup>11</sup> Judd and Lyons Resection of the Body of the Stomach for Ulcer ANNALS OF SURGERY, 1922, vol lxxvi, p 409
- <sup>12</sup> Downes The Operative Indications in Hour-glass Stomach Surg Gyn and Obst, 1918, vol xxxi, p 1
- <sup>13</sup> Berg The Influence of Gastro-enterostomy on Gastric and Duodenal Ulcers J Am M Assoc, 1913, vol lx, p 881
- <sup>14</sup> Haberer Anwendungsbreite und Vorteile der Magen-resektion Billroth I Arch f Klin Chir vol cxiv, p 127
- <sup>15</sup> Sherren Treatment of Duodenal Ulcer Harveian Soc Lancet, 1923, vol 1, p 653

## INFANTILE PYLORIC STENOSIS

By W. FRANK FOWLER, M.D.

OF ROCHESTER, N.Y.

THE voluminous literature regarding the so-called congenital hypertrophic pyloric stenosis illuminates the subject from many angles. Various phases of the problem, however, remain obscure. Therefore, an inventory of the accumulated facts and theories concerning infantile pyloric stenosis seems justifiable.

Osler<sup>1</sup> rescued from oblivion the original graphic description by Beardsley<sup>2</sup> in 1788. Beardsley stated that a male child "in the first week of its infancy was attacked with an ejection of the milk and of every other substance it received into its stomach almost instantaneously and very little changed." The boy led a miserable existence and died at the age of five years. Necropsy revealed that "the pylorus was invested with a hard compact substance or schirrosity which so completely obstructed the passage into the duodenum as to admit with the greatest difficulty the finest fluid."

Regarding frequency, Hill<sup>3</sup> discovered the condition in five out of 1000 infants. Pehu and Pinci<sup>4</sup> compiled thirty-eight cases of infantile pyloric stenosis in France and seven in Italy. These figures from the Latin lands are in marked contrast to the many cases reported from the Anglo-Saxon and German countries.

The etiology of the hypertrophy remains problematical. Thomson<sup>5</sup> contends that the enlargement is a work hypertrophy resulting from spasm. Many observers, however, agree with Hirschsprung<sup>6</sup> that the hypertrophy is a true congenital malformation. In confirmation of the latter contention Dent<sup>7</sup> found the tumor in a seven months' foetus. Walls<sup>8</sup> states that the hypertrophy has been seen in children that were still-born and Green and Sidbury<sup>9</sup> observed a definite pyloric tumor at operation in a baby three days old.

The pathology is definite. Wollstein,<sup>10</sup> for example, reports twenty-three post-operative necropsy findings. In each instance the circular muscle fibres were hypertrophied without connective-tissue hyperplasia. The submucosa was often oedematous. There was no mucosal inflammation. The normal thickness of the pyloric circular muscle under three months of age is not greater than 2.5 mm. The hypertrophied muscle at this age showed a circular layer of from 3 to 7 mm. in thickness. The average was 4.4 mm.

The syndrome restated merely for purposes of discussion comprises (1) projectile vomiting, (2) tumor, (3) peristaltic waves, (4) gastric retention, and (5) rapid loss of weight.

Regarding recognition of the tumor Bolling<sup>11</sup> states that the mass was palpated in all but one of 454 cases. Still<sup>12</sup> failed to feel the tumor only twice in 248 cases and Poynton and Higgins<sup>13</sup> palpated the hypertrophy in

all of them 55 cases. On the other hand, Lewisohn<sup>11</sup> and others find that often the tumor is not palpable. And Strauss<sup>15</sup> contends that the feeling of the mass is a matter of personal equation.

The tumor may usually be felt a little to the right and above the umbilicus. We are reminded, however, by Gray and Pirie<sup>16</sup> that occasionally the mass may be lower. And Holt<sup>17</sup> states that there is apt to be considerable variation in its position. In a case of mine, for example, three observers felt the tumor, two of us together and one independently, slightly below the level of the umbilicus.

Downes<sup>18</sup> agrees with Gray and Pirie that the presence of the so-called tumor is pathognomonic of the disease. Still believes that the only absolute proof short of opening the abdomen is feeling the tumor and Poynton and Higgins hold that operation is rarely indicated without palpating the mass. Haggard<sup>19</sup> merely states that visible peristalsis is the best evidence except the tumor when felt. And other observers contend that the existence of the characteristic syndrome without feeling a tumor justifies the diagnosis.

Thomson, for example, stresses the significance of well-marked, forcible peristalsis and Holt emphasizes the diagnostic importance of abnormal gastric retention. Palmer<sup>20</sup> depends upon the diagnostic triology explosive vomiting, iso-peristaltic waves and tumor in the order named.

Strauss relies upon the roentgenologic examination to sharply differentiate the medical from the surgical cases according to the degree of gastric retention. LeWald<sup>21</sup> also expresses confidence in the diagnostic value of the Rontgen-rays. Downes,<sup>22</sup> however, considers the examination unnecessary and in some instances harmful except occasionally. Geistley and Wilhelm<sup>23</sup> state that the roentgenologic examination tends to increase the vomiting. Projectile vomiting occurred in one of my little patients soon after the barium meal but not before two radiographs had been made by Dr. S. C. Davidson. Richter<sup>24</sup> warns us that the Rontgen-ray should not be relied upon to determine the patency of the pylorus. We cannot exclude the diagnosis of hypertrophic stenosis on the basis of the passage of bismuth. In two cases this error was made and operation advised against. The diagnosis was confirmed in one instance at necropsy and in the other at a late operation which failed to save the baby.

Richter contends that the Rontgen-ray dependably indicates the rate of emptying time of the stomach.

However, the great diagnostic value of the roentgenologic examination is demonstrated by the accompanying illustration and by Doctor Davidson's description of his findings.

Many pediatricians contend that the gastric retention is sufficiently confirmatory and may be accurately gauged by the withdrawal of a measured test-meal.

Diagnosis is sometimes difficult. The early symptoms are not always characteristic. Every change of food may be followed by a temporary cessation of vomiting and the physician naturally infers that he is dealing merely

with a feeding problem. A patient of mine, for example, developed normally for a month. Then the mother's milk failed and coincident with the weaning vomiting began. The vomiting continued in spite of dietetic changes. Soon after the characteristic symptoms appeared the Rammstedt operation was performed when the baby was seven weeks old.

Medical treatment rests upon the theory that the pyloric obstruction is spasmodic rather than mechanical. Sauer<sup>25</sup> in 1918 suggested the use of thick cereal feeding. Under this treatment the vomiting soon stopped, but usually the peristaltic waves and the tumor when palpated persisted for weeks



FIG 1—STOMACH. Fluoroscopic and radiographic examinations. A thin solution of malted milk containing barium sulphate was administered. The child could only retain about one ounce. The solution was observed to drop into what appeared to be a dilated stomach. The radiographs demonstrated a stomach dilated to more than twice the normal size. The outlines of the lesser and greater curvatures were quite regular, the pyloric end of the stomach ending up rather bluntly but evenly. The pylorus was not outlined nor was the duodenum demonstrated. No barium was observed to enter the small intestine. Conclusion: There is presented a markedly dilated stomach which is secondary to some form of benign stenosis of the pylorus.

or months. Sauer<sup>26</sup> continues the cereal feeding for from five to eight weeks. Then if vomiting is not provoked by the thin food, the child will tolerate a milk mixture without much trouble in spite of the peristaltic waves and the palpable tumor. Twenty-eight patients were treated by this method with one sudden death. During the same period seven patients had surgical treatment. Two of them died.

Porter treated ten patients with the thick formula and all of them recovered.

Haas<sup>27</sup> in 1919 first advocated the administration of atropin. The flushing, mydriasis, fever, dryness of the lips and mouth, inability to secrete tears, irritability, quick, jerky movements, pallor and drowsiness induced by the drug are harmless and transitory. The duration of this treatment, according to Haas, varied from a few weeks to most of the first year. Haas<sup>28</sup> reported the treatment of 40 patients by this method. One patient died suddenly and one came to operation. The others recovered, although surgical treatment had been advised for over 20 per cent of them.

# INFLAMMED PYLORIC SINUSIS

Sedgwick treated breast milk to 21 infants and lost but one. "Holt" applied the same treatment to 21 infants with a mortality of 20 per cent. "Hirshum" collected from the German literature reports of eighty-three patients treated medically with a mortality of 20 per cent. "Holt" cured twenty-six of his fifty-four patients and "Paterson and Darling" cured two of their thirty-six patients.

Regarding the method, Thomas stated that we cannot expect the "moderate" treatment to greatly hasten the absorption of the procoagulant. Yet, the "high" dose to relieve it, however, "not sufficient to cause the clot" but the "optimum dose" for continuation of the observation and treatment of the patient. The "high" dose is to occur.

[illegible]

Michael said that, though it is the responsibility of the police to protect the public, they must not be overbearing and must not be overreactive. He said that the police must be able to deal with the public in a fair and reasonable manner. He said that the police must be able to deal with the public in a fair and reasonable manner.

[illegible]

Thomson on the other hand, considered the case of the child of 1 year followed up after medical treatment of a case of congenital intestinal derangement. The ages of the children, at the time of the operation, have varied from ten months to sixteen years, and have been eight. Recovery was apparently complete. Both prices that proved the existence of the condition, and no symptoms after the first year, but which they could be taken as the basis of palpable obstruction in later life.

Veeder, Clopton and Mills—studied each child from roentgenologically. They had been subjected to operation and their bones had been treated medically. In the group were sister and brother. The sister had been treated medically, and had a very difficult first year. She had never been a strong and healthy child, and has about the same physical development as her brother two years younger, who had had a Rammstedt operation. The roentgenologic examination revealed no abnormality in either child. The little girl evidently was a victim of arrested development. The investigators have heard of no similar instance.

Analysis of the medical treatment of infantile pyloric stenosis reveals that in one series in which all the patients recovered, several of the cases lacked some of the characteristic symptoms.

Bolling avers that no medical treatment that involves taking a breast-fed baby off the breast is admissible. Still believes that the possibility of retaining the breast feedings should decide in favor of immediate operation rather than risk the loss of the mother's milk through her prolonged anxiety.

during the medical treatment. And Goldbloom and Spence<sup>36</sup> have learned that the mortality from pyloric stenosis among the artificially fed infants is three times that of the breast fed. Yet some of the pediatricians deliberately take the infant from the mother. Porter<sup>37</sup> states that one baby vomited the breast milk but not the thick feeding. The infant was, therefore, gradually taken from the breast.

The prolonged period of disability incident to medical treatment, the tediousness of the thick feeding and the alarming toxic symptoms of atropin militate against these methods. They fail from the economic standpoint and from the viewpoint of the anxious mother. Also the danger of intercurrent diseases constantly threatens. And Kerley<sup>38</sup> reminds us that sudden and unexpected deaths in the palliatively treated cases are not uncommon, possibly from acidosis.

Finally, the pyloric hyperplasia remains. Richter states in this connection that the mere permanency of the tumor is not a surgical argument. Since the mass is not a neoplasm but merely a muscular hypertrophy, it should ultimately disappear. Operation is indicated, however, because the obstruction does not disappear quickly enough.

The duration of the hypertrophy is uncertain. Lewis and Grulee<sup>39</sup> describe the obstructive tumor as observed at necropsy eight months after a gastro-jejunostomy. From the duodenal side the enlargement projected into the lumen of the bowel as the uterine cervix projects into the vagina. The lumen of the pylorus viewed from the stomach side was greatly reduced in size and surrounded by a rigid wall. A fine probe could be passed through the opening. Holt saw the tumor apparently unchanged four years and seven months after a gastro-jejunostomy. Shaw<sup>40</sup> reported that necropsy on a boy at five years showed the pylorus to be a hard resisting mass of hypertrophied tissue. The canal would admit a probe under pressure, but was absolutely tight to all fluids owing to a swollen and twisted condition of the mucous membrane. Walton<sup>41</sup> and others report similar findings.

Heubner<sup>42</sup> has observed symptoms of pyloric obstruction persisting into the third, fourth and seventh years of life. Truesdale<sup>43</sup> advances the likely hypothesis that "If this congenital deformity is one of degree, there follows the natural assumption that an individual who has had gastric discomforts so long as he can remember may have a partial stenosis that is congenital." Two of Truesdale's specimens "showed a fusiform overgrowth of the pyloric muscle corresponding to the arrangement of muscle fibres in the congenitally hypertrophied pyloric muscle. In one of these cases the history of gastric disturbance dated to a period as remote as the patient could remember."

Under the title "Congenital Hypertrophic Pyloric Stenosis in the Adult," Oliver<sup>44</sup> convincingly reported the history, operative findings and result in a man fifty-one years old. The patient had suffered from stomach trouble all his life. His mother stated that when he was an infant she "had a terrible time raising him. Then and later he was undernourished, vomited fre-

## INFANTILE PYLORIC STENOSIS

quently and had periodic attacks of biliousness." The symptomatology, the physical findings, the observations at operation, the operation itself (Rammstedt procedure) and the outcome were suggestive. They resembled strikingly pyloric stenosis and the relief from timely surgery as usually observed during early infancy.

The surgical treatment of infantile pyloric stenosis is based upon the observation of mechanical obstruction at the operation. No one who has seen the oedematous tumor *in situ*, felt its extreme hardness, perceived its remarkable thickness when severed and the bulging of the mucosa between the cut muscle fibres can doubt the mechanical nature of the obstruction.

Downes in 1916 stated that "Oedema in varying degrees involving the pylorus and pyloric region of the stomach was present in all cases. We believe the presence of this oedema is the factor which determines the definite onset of symptoms." Sparrow,<sup>45</sup> Haggard and Wall<sup>46</sup> quote this opinion without comment. Lewisohn and Morrison<sup>47</sup> contend that a malformation exists at birth with later oedema. And Palmer and Barr<sup>48</sup> agree that the oedema plus the hyperplasia without spasm causes the obstruction. All surgeons observe the oedema but few evaluate it.

The mechanism of the obstruction is explained by Downes in the statement that "the effort necessary to force food through the narrowed and elongated pyloric lumen produces circulatory disturbances resulting in oedema. As the food increases in amount the muscular effort becomes greater and the lumen narrows down. Finally at the tenth day or a little later it becomes more or less completely obstructed."

In 1916, Downes subjected the bad risks to immediate emergency operation. Now, however, Bolling emphasizes the value of hypodermoclysis and transfusion for these patients delaying operation for from twenty-four to seventy-two hours. The mortality from collapse within seventy-two hours after operation has thus been materially reduced.

Regarding the infant as a surgical risk, an editorial writer<sup>49</sup> reminds us that "despite the drawbacks incident to diminutive proportions and other graver reactions the infants nevertheless recuperate after laparotomies much better than adults. The child, for example, has a greater margin of reserve than the adult, his tissues are more capable of adaptation of function and more vigorous in repair. Also, his blood-making system exhibits greater activity and his comparatively undifferentiated nervous system is less mobile and less unstable.

"Why then should Rammstedt's operation possess such a high mortality rate? The chief reason is that the infant with hypertrophic stenosis is a starved animal with lowered resistance to trauma, to shock and to infection of the intestinal mucosa. The operation is often a last resort after medical measures have failed.

"The factors of success in operating upon young children are above all gentleness in the manipulation of their delicate tissues; speed without roughness; the avoidance of blood loss and finally the minimum intra-abdominal



trauma and exposure of the viscera with conservation of the body heat." A properly executed Rammstedt operation meets these requirements.

Goldbloom and Spence concluded from their analysis of 163 cases that the prognosis in the operated cases of infantile pyloric stenosis depended upon four factors. First, if the duration of the symptoms, chiefly vomiting prior to operation, was under four weeks the mortality was 13.4 per cent., if over four weeks 35.42 per cent. Second, if the infants were breast-fed 11.3 per cent. succumbed, if artificially fed 35 per cent. died. Third, if the weight was seven pounds or more the mortality was 8.7 per cent., if under seven pounds the mortality increased to 28 per cent. And fourth, the mortality of the entire group, whether breast or artificially fed, increased directly with the percentage of the weight loss. If the loss was less than 20 per cent. of the best weight, the mortality was 6.58 per cent. If the loss was 20 per cent. or more, the mortality rose to 37.25 per cent.

The Rammstedt procedure need be discussed merely as regards the technical errors and the complications. Chief of the former is the opening of the duodenum. Many surgeons report this accident. The recent practice of bluntly dividing the deeper muscle fibres, however, is relatively safe. Gray and Pirie maintain that the obstruction can be relieved without dividing the pylorus far enough on the duodenum to enter the lumen. The division should stop just short of the point where the white, avascular coat merges into the normal vascular structure of the duodenum. Palmer concurs in this opinion. Anyhow, the closed perforation should usually be innocuous. One wonders, however, if some of the rare deaths from unexplained peritonitis may not have been due to undiscovered minute openings.

Serious or fatal hemorrhage may occur from unsecured vessels in the pyloric incision or in the abdominal wound. Rarely the bleeding results from true hæmophilia. Adequate hæmostasis as described by Bolling and pre-operative precaution should largely obviate these dangers.

Material infection of the incision, according to Bolling, is unusual. If omphalitis exists, however, infection of the wound is almost inevitable. Complete separation of the abdominal wound has been observed by Apt.<sup>50</sup> Provided layer suturing has been done, the failure of union indicates extreme debility. Lewis<sup>51</sup> in this connection warns us against an incision through the linea alba. Occasionally a ventral hernia develops which may or may not require subsequent repair. A few instances of adhesions and intestinal obstruction have been reported. Operative trauma perhaps has been responsible for these. Deaths from gastro-enteritis and sudden unexplained deaths usually follow late operations.

The importance of the post-operative care is uniformly stressed, particularly as regards the feeding of breast milk. Post-operative vomiting is not uncommon and the amount of the feedings must be increased cautiously. The coöperation of the pediatrician is essential. The sutures are removed on the tenth post-operative day. Then in the absence of surgical complications the care of the infant devolves upon the pediatrician. The dietetic

## INFANTILE PYLORIC STENOSIS

disturbances outlast the pyloric obstruction. The duration of hospital care after the operation varies from two to three weeks.

Regarding healing, Ransahoff and Wolley<sup>52</sup> report necropsy findings seven months after a Rammstedt operation. There was no herniation at the site of the pyloric incision. A smooth, linear, fibrous scar joined the cut muscle fibres. The tumor was gone. The muscle layer was possibly a little better developed than normal. Wollstein reports nearly identical findings.

The operative mortality during recent years has steadily decreased. Bolling, for example, reports the results of 454 Rammstedt operations performed since 1914 by Downes and himself. The mortality for the first 175 cases in this series was 17.1 per cent., whereas the mortality among the last 30 patients was only 8.5 per cent. The mortality for the entire series was nearly 15 per cent. Poynton and Higgins report twenty cases treated during 1920 and 1921 with an operative mortality of just under 45 per cent. The surgical mortality for the thirty-five patients who were treated during 1922 and 1923, however, was less than 15 per cent. The improvement was due to earlier operations. Mixer<sup>53</sup> reports 195 operations with two deaths, a mortality of 9.5 per cent. Strauss,<sup>54</sup> in 1920, reported 103 operations with three deaths. Palmer, in 1919, reported twenty-two operations with two deaths. Porter, in 1919, reported twenty-two operations with one death. And Green and Sidbury, in 1919, and Lewis, in 1920, reported five operations with no mortality.

On the other hand, Parsons and Barling, in 1923, reported fifty Rammstedt operations with twenty-four deaths. Such a mortality implies delayed surgery. Indeed, Parsons and Barling estimate that early operations would be curative in at least 80 per cent. of the cases.

Opinions regarding treatment vary. Gerstley and Wilhelmi state that in ten years they have not seen a case that required operation. Haas avers that surgery should be a rarity and only after a trial of atropin. Sauer observes that good results are often obtained without surgery. He voices the dilemma of the pediatrician, however, in the statement that operation soon after the diagnosis is made may be an unnecessary operation. On the other hand, persistence in unsuccessful feeding may increase the surgical risk. Thomson believes that medical treatment cannot greatly hasten the opening of the passage. Eventually the pylorus will open spontaneously and the child recover completely provided he does not die in the process. If the pyloric lumen has been efficiently opened up by a surgical operation, however, the gain in weight usually sets in rapidly. Kerley maintains that low mortality in pyloric stenosis depends upon early diagnosis and immediate operation. This does not mean, however, that a child with a palpable tumor cannot recover without an operation. Haggard affirms that only the very mild cases without contractions of the tumor and with only partial retention should have medical treatment. All others should be treated by operation just as any other mechanical obstruction in the alimentary canal. Parsons and Barling hold

that Rammstedt's operation preceded and followed by a careful medical régime offers the best means of reducing the high mortality of the disease. Downes noted in 1920 that increasing numbers of babies were being referred by the pediatricians for operation. And Sparrow thinks that we are undergoing the same transitional stage of expectant treatment in this disease as we have been through in appendicitis and gall-stones. Observers agree that sudden, unexplained deaths occur under both medical and surgical treatment in the prolonged cases.

## SUMMARY

Since Beardsley first described infantile pyloric stenosis in 1788, conjecture has been rife regarding the etiology. Some theorists maintain that the enlargement is a work hypertrophy resulting from spasm. Most observers, however, contend that the hypertrophy is a congenital malformation with spasm and œdema added. The symptomatology is well known and characteristic.

The pathology consists of simple hypertrophy of the circular muscle fibres. Some observers palpate the tumor usually or always, but to others such recognition is often impossible. Some believe that the diagnosis hinges upon feeling the tumor, but others consider its palpation unessential. The Röntgen-ray sheds brilliant diagnostic light. Debilitated infants, however, are not fit subjects for the examination. And the patency of the pylorus cannot always be accurately determined. Gastric retention may also be gauged by the test meal. Uncharacteristic early symptoms sometimes delay the diagnosis.

Medical treatment rests upon the theory that the obstruction is due to spasm. Recent medical methods appear successful in some hands, but the critics contend that the obstruction remains and must be slowly overcome. Nevertheless, some observers maintain that the infants suffer no permanent harm. Arrested development was noted, however, in one instance. A statistical comparison of the results of medical and surgical treatment is difficult since cases lacking some of the characteristic symptoms are included in the medical series. Also, surgery is often the last resort. The removal of the infant from the breast, the prolonged period of disability, the tediousness of the thick feeding and the alarming toxic symptoms of atropin militate against medical treatment. Also, the danger from intercurrent infections constantly threatens and sudden, unexpected deaths sometimes occur.

The duration of the hypertrophy too is uncertain. Necropsy has revealed the obstructing tumor in a boy five years old. Symptoms of pyloric obstruction have been observed persisting into the third, fourth and seventh years of life. And pyloric stenosis, apparently congenital, was noted at operation in a man fifty-one years old.

The surgical treatment is based upon the observation of mechanical obstruction at operation. The effort necessary to force food through the narrowed and elongated pyloric lumen results in œdema. The œdema necessitates greater effort and this increased effort perpetuates the œdema.

## INFANTILE PYLORIC STENOSIS

Finally obstruction becomes more or less complete. Pre-operative preparation is essential for the bad risks. The surgical accidents are opening the duodenum and hemorrhage. Both are preventable. Infection of the incision ordinarily is rare. In the presence of omphalitis, however, it is practically inevitable. Complete separation of the properly placed abdominal incision can be prevented by layer suturing, except in the extremely debilitated infants. The post-operative care is uniformly stressed, particularly as regards the feeding of breast milk. The coöperation of the pediatrician is essential.

In general the infant recuperates after laparotomies much better than the adult. Successful surgery upon babies, however, demands gentleness, speed, the avoidance of blood loss and of exposure of the viscera and the conservation of the body heat. A properly executed Rammstedt procedure meets these requirements. The prognosis after the Rammstedt operation depends, also, upon the duration of symptoms, whether or not the infant was breast fed, the weight at the time of operation and the percentage of the weight loss. The Rammstedt operation is followed by smooth healing of the pyloric incision without herniation of the mucosa. The tumor disappears. Opinions regarding treatment differ. Some pediatricians contend that operation is seldom if ever necessary. On the other hand, one observer asserts that we are undergoing the same transitional stage of expectant treatment in this disease as we have been through in appendicitis and gall-stones. Sudden deaths occur with any type of treatment in the prolonged cases. The mortality after the Rammstedt operation is still too high, chiefly because infants with pyloric stenosis have lowered resistance to trauma, to shock and to intestinal infections. And operation is often a last resort. Nevertheless, in one large series of cases the surgical mortality has been reduced 50 per cent. since 1920.

## CONCLUSION

Timely operations for the relief of infantile pyloric stenosis conducted under the recent improved pre-operative and post-operative care and operative technic will decrease the surgical mortality everywhere. Coincidentally, the general death rate of the disease will fall.

## REFERENCES

- <sup>1</sup>Osler, Sir William: Reprinted Description by Beardsley, Hezekiah, in Arch. Pediat., 1903, vol. xx, pp. 355-357.
- <sup>2</sup>Beardsley, Hezekiah: Cases and Observations. Med. Soc., New Haven County, 1788, pp. 81-84.
- <sup>3</sup>Hill, Roland: Discussion of Downes' Paper. J. A. M. A., July 24, 1920, p. 232.
- <sup>4</sup>Pehu, M., and Pinel, X.: Pyloric Disease in Infants. Abst., J. A. M. A., October 29, 1921.
- <sup>5</sup>Thomson, John: Observations on Congenital Hypertrophy of the Pylorus. Edinburgh Med. Jour., January, 1921.
- <sup>6</sup>Hirschsprung: Quoted by Green and Sidbury.
- <sup>7</sup>Dent: Quoted by Bolling.
- <sup>8</sup>Walls, Frank X.: Discussion of Papers of Strauss and Haggard. J. A. M. A., September 7, 1918, p. 811.

W. FRANK FOWLER

- <sup>9</sup> Green, Thomas M., and Sidbury, J. Buren: Hypertrophic Stenosis of the Pylorus in Infants. *Surg., Gynec. and Obstet.*, February, 1919.
- <sup>10</sup> Wollstein, Martha: Healing of Hypertrophic Pyloric Stenosis after the Fredet-Rammstedt Operation. *Amer. Jour. of Diseases of Children*, June, 1922.
- <sup>11</sup> Bolling, Richard W.: Congenital Hypertrophic Pyloric Stenosis: A Review of 454 Cases in Which the Fredet-Rammstedt Operation was Performed. *J. A. M. A.*, July 4, 1925.
- <sup>12</sup> Still, George F.: Congenital Hypertrophy of the Pylorus. *Brit. Med. Jour.*, April 7, 1923.
- <sup>13</sup> Poynton, F. John, and Higgins, J. M.: Present Position of the Treatment of Hypertrophic Pyloric Stenosis. *Lancet*, February 2, 1924.
- <sup>14</sup> Lewisohn, Richard: Clinical and Experimental Studies on Congenital Pyloric Stenosis. *Surg., Gynec. and Obstet.*, March, 1918.
- <sup>15</sup> Strauss, Alfred A.: Clinical Observations of Congenital Pyloric Stenosis: Report of Operations in 101 Cases. *J. A. M. A.*, September 7, 1918.
- <sup>16</sup> Gray, H. Tyrell, and Pirie, George R.: Congenital Hypertrophic Stenosis of the Pylorus. *Lancet*, September 20, 1919.
- <sup>17</sup> Holt, L. Emmet: Hypertrophic Stenosis in Infants. *J. A. M. A.*, May 26, 1917.
- <sup>18</sup> Downes, William A.: The Operative Treatment of Pyloric Obstruction in Infants; with a Review of Sixty-six Personal Cases. *Surg., Gynec. and Obstet.*, March, 1916.
- <sup>19</sup> Haggard, William D.: Hypertrophic Pyloric Stenosis in Infancy. *J. A. M. A.*, September 7, 1918.
- <sup>20</sup> Palmer, Dudley W.: Congenital Hyperplastic Pyloric Stenosis. *Arch. Pediat.*, September, 1922.
- <sup>21</sup> LeWald: Discussion of Downes' Paper. *J. A. M. A.*, July 24, 1920.
- <sup>22</sup> Downes, William A.: Congenital Hypertrophic Pyloric Stenosis: Review of 175 Cases in Which the Fredet-Rammstedt Operation was Performed. *J. A. M. A.*, July 24, 1920.
- <sup>23</sup> Gerstley, Jesse R., and Wilhelmi, L. J.: Pyloric Stenosis in Infancy. *Med. Clinics of North America*, September, 1924.
- <sup>24</sup> Richter, H. M.: Congenital Pyloric Stenosis. *J. A. M. A.*, January 31, 1914.
- <sup>25</sup> Sauer, L. W.: The Use of Thick Farina in the Treatment of Pyloric Stenosis. *Arch. Pediat.*, July, 1918.
- <sup>26</sup> Sauer, L. W.: A Further Contribution to the Study of Pyloric Stenosis. *Amer. Jour. of Diseases of Children*, August, 1921.
- <sup>27</sup> Haas, Sidney V.: Atropin Treatment of Pylorospasm and Pyloric Stenosis. *Arch. Pediat.*, October, 1919.
- <sup>28</sup> Haas, Sidney V.: Congenital Hypertrophic Pyloric Stenosis and Its Treatment by Atropin. *J. A. M. A.*, October 14, 1922.
- <sup>29</sup> Sedgwick: Quoted by Sauer.
- <sup>30</sup> Heubner: Quoted by Sauer.
- <sup>31</sup> Ibrahim: Quoted by Sauer.
- <sup>32</sup> Parsons, Leonard G., and Barling, Seymour G.: An Inquiry into Pyloric Stenosis of Infants. *Lancet*, January 13, 1923.
- <sup>33</sup> MacDonald, W. G.: Two Cases of Congenital Hypertrophic Pyloric Stenosis Saved by Early Operation. *Lancet*, February 26, 1921.
- <sup>34</sup> Faber, K. G.: Congenital Stenosis of the Pylorus and Duodenum. *Abst., J. A. M. A.*, December 4, 1920, p. 1603.
- <sup>35</sup> Veeder, Borden S., Clopton, Malvern B., and Mills, R. Walter: Gastric Motility after Pyloric Obstruction in Infancy. *Amer. Jour. of Diseases of Children*, November, 1922.
- <sup>36</sup> Goldbloom, Alton, and Spence, Ralph C.: Prognosis in Operated Cases of Hypertrophic Stenosis of Pylorus. *Amer. Jour. of Diseases of Children*, April, 1920.

## INFANTILE PYLORIC STENOSIS

- <sup>37</sup>Porter, Langley: A Retrospect of Fifteen Years' Experience in the Treatment of Hypertrophic Pyloric Obstruction in Infants. *Arch. Pediat.*, July, 1919.
- <sup>38</sup>Kerley, Charles Gilmore: Twenty-six Cases of Hypertrophic Stenosis of the Pylorus in Private Practice. *J. A. M. A.*, January 4, 1919.
- <sup>39</sup>Lewis, Dean, and Grulee, Clifford G.: The Pylorus after Gastro-enterostomy for Pyloric Stenosis. *J. A. M. A.*, January 30, 1915.
- <sup>40</sup>Shaw, F. W.: Congenital Hypertrophic Stenosis of the Pylorus. *Abst., Arc. Pediat.*, 1903, vol. xx, p. 703.
- <sup>41</sup>Walton, Albert J.: Congenital Pyloric Stenosis. Autopsy Seven Months after Gastro-enterostomy. *ANNALS OF SURGERY*, September, 1914.
- <sup>42</sup>Heubner: Quoted by Richter.
- <sup>43</sup>Truesdale, P. E.: The Pylorus: Observations upon its Musculature. *Surg., Gynec. and Obstet.*, September, 1915.
- <sup>44</sup>Oliver, John Chadwick: Congenital Hypertrophic Stenosis of the Pylorus in an Adult. *ANNALS OF SURGERY*, October, 1922.
- <sup>45</sup>Sparrow, Charles A.: Congenital Hypertrophic Pyloric Stenosis. *Boston Med. and Surg. Jour.*, August 25, 1921.
- <sup>46</sup>Wall, Joseph S.: Pyloric Stenosis of Infancy. *Arch. Pediat.*, April, 1919.
- <sup>47</sup>Morrison, William Reid: Congenital Stenosis of the Pylorus. *Boston Med. and Surg. Jour.*, October 30, 1924.
- <sup>48</sup>Barr, Richard A.: Congenital Pyloric Stenosis. *The Jour. of the Tennessee State Med. Assn.*, January, 1925.
- <sup>49</sup>Editorial: The Surgery of Infants. *Lancet*, January 13, 1923.
- <sup>50</sup>Apt, I. A.: Discussion of Papers of Strauss and of Haggard.
- <sup>51</sup>Lewis, Dean: Discussion of Downes' paper.
- <sup>52</sup>Ransahoff, J. Louis, and Wolley, Paul G.: Operative Cure of Congenital Pyloric Stenosis. *J. A. M. A.*, 1917, vol. lxviii, p. 1543.
- <sup>53</sup>Mixter, Charles G.: Discussion of Bolling's paper.
- <sup>54</sup>Strauss, Albert A.: Quoted by Downes. *J. A. M. A.*, July 24, 1920.

# NOTE ON BENIGN TUMORS OF THE DUODENUM

By A. MURAT WILLIS, M.D.

PROFESSOR OF SURGERY IN THE MEDICAL COLLEGE OF VIRGINIA

AND

MARTIN LASERSOHN, M.D.

INSTRUCTOR IN MEDICINE

OF RICHMOND, VA.

THE senior author of this paper in December, 1919, in a paper entitled "Intussusception Resulting from Benign Tumor of the Intestine," reported three cases of benign tumor of the small intestine producing intussusception. These cases occurred in children from five to sixteen years of age. One was a fibroma, the other two adenoma. Attention was also called to the few cases of adenoma that had been reported in the literature. Since the appearance of that article two adenomata of the duodenum in adults have come under our observation. We feel that the occurrence of adenoma of the duodenum in the adult is sufficiently uncommon to justify the report of the two following cases.

CASE I.—B. M., colored, male, age sixty-three years, farmer. Entered St. Philip's Hospital for colored patients on the service of Dr. A. Murat Willis on August 1, 1923. Discharged September 4, 1923.

The patient dated onset of trouble to two months previous to admission. A dull and not severe pain in the epigastrium called the patient's attention to a hard "knot," the size of a fist, in the region of the umbilicus. The pain seemed to be localized, as a rule, to this "knot." At the same time there would be some nausea. The nausea, the patient stated, was worse when the stomach was empty. Since the onset he had vomited twice—a clear, mucoid fluid containing no blood or food. Since the onset of his trouble there had been a gradual loss of appetite and a loss of fifteen pounds of weight. Bowels were always regular but of late he was constipated and troubled with gas. The patient stated that the knot seemed to be growing smaller, but the "misery" in the abdomen was not decreasing any. No attacks of diarrhœa. Never noticed any blood in the stools. Never been jaundiced. The patient had no other symptoms except failing vision in the left eye.

*Past History.*—Measles, mumps, pertussis, varicella. There was a history also of once having had an illness which resembled typhoid fever. No operations. Gonorrhœa when fifteen years old; later inguinal adenitis with surgical drainage and healing. No history of a chancre. Has partaken of alcohol moderately. No tobacco. Marital history unimportant. The family history was unimportant.

*Physical Examination.*—Well-built and well-preserved colored male, in no acute pain or discomfort. The eyes showed no jaundice. There was a pterygium on the nasal side of each eye; an incipient cataract on the right, and a nearly mature cataract on the left. Pupils reacted well. The teeth and gums showed considerable caries and marked gingivitis. The lungs were clear. The heart was normal in size, rate and rhythm. The arteries showed general sclerosis, compatible with the patient's age. The blood-pressure was 126 mm. systolic and 70 mm. diastolic. The abdomen appeared sunken below the costal margins and iliac crests. No visible peristalsis or mass. No hernia. On raising

## NOTE ON BENIGN TUMORS OF THE DUODENUM

the head slight diastasis of the recti muscles was evident. A small, firm nodule the size of a pecan nut was visible and palpable in the left upper quadrant near the costal margin. This nodule appeared to be in the abdominal wall and freely movable. The abdominal muscles showed no rigidity. The spleen, liver and kidneys were not palpable. No tenderness could be elicited anywhere. The aortic pulsation could be felt to the left of the umbilicus. When put on his hands and knees and in the knee-chest position no mass could be felt.

The spine appeared entirely normal. Knee-kicks were obtainable on reinforcement. On the left thigh, lateral surface, there was a rather soft, subcutaneous tumor the size of a marble. This was freely movable and appeared to be not as firm. Rectal examination revealed no fissure or fistula, no hemorrhoid or tabs. The prostate seemed a little large but of normal consistency. The lateral lobes could be well outlined. No masses felt.

The urine was negative. The blood was normal in all respects. The blood Wassermann was negative.

Gastro-intestinal X-ray examination showed a stomach of "J" shape reaching the promontory of the sacrum in upright position with the appearance of an annular filling defect close to the pylorus. A well-filled duodenal bulb could not be obtained and this structure seemed to be irregular. At the six-hour period no evidence of obstruction or delay was observed. This examination seemed to indicate that there was a lesion involving the pyloric portion of the stomach, malignancy, adhesions or scar tissue being suggested as a cause.

On August 3 an exploratory laparotomy was done. A large polypoid tumor was found to be present in the duodenum. This tumor was attached by a pedicle one inch long (2.5 cm.) to the posterior wall of the duodenum, the place of attachment of the pedicle being about one inch (2.5 cm.) distal to the pyloric sphincter. On manipulation the tumor could be forced through the pyloric sphincter. Through the right rectus incision an incision was made in the duodenum about 2 inches (5 cm.) distal to the pyloric sphincter, exposing the tumor attached to the posterior wall of the duodenum by its pedicle. The tumor was removed, first tying off the pedicle. The post-operative course was uneventful.

On August 22 the cataract was removed from the left eye. On September 4 the patient was discharged.

*Gross Description.*—The tumor was much larger when felt *in situ* than when weighed after removal. In the gut it appeared to be the size of a small fist. After removal it weighed 12 gms. It felt firm—the surface had a lobulated appearance, the individual lobes appearing smooth. After removal, the pedicle measured (1.5 cm.) long. The tumor measured 3.5 cm. x 3 cm. x 2 cm. On section the lobulated appearance noted before was seen to continue in well-defined lobes.

*Microscopic Description.*—The tumor was made up of the structural element of Brunner's glands. Acini were numerous, the arrangement being irregular. The cells were single layers, perhaps larger than normal, and contained within the basement membrane. The mass was covered with mucosa. No mitoses seen. Autolysis was rapid. Pathological diagnosis: Adenoma.

CASE II.—Mrs. L. D., white, female, housewife, age sixty-two. Entered the Johnston-Willis Hospital on the service of Drs. A. Murat Willis and Frank S. Johns, August 27, 1924. Discharged October 16, 1924. Patients chief complaint was pain in upper abdomen and jaundice. Family history was negative except one sister had tuberculosis. Patient had the usual childhood diseases, had "rheumatism" of five months' duration ten years ago, and



a slight attack of influenza two years ago. She had had no operation. Her cardio-respiratory history was negative except slight dyspnoea on exertion and some oedema of extremities. Chronic constipation and nocturia were symptoms. Had been bothered with hemorrhoids. Married forty-six years; had six children. Menopause twenty years ago.

Her present illness began on January 1, 1924, when patient suffered a severe colicky pain in her upper abdomen, more to the right, radiating to her neck and shoulders. At that time she had a chill accompanied by nausea vomiting and fever. This lasted about twenty-four hours. About a week later she suffered a similar attack and these attacks were repeated at about monthly intervals until July when the pain and discomfort became

continuous and she noticed a yellow tinge of her skin which persisted. During this time she had almost continuously a sensation of heaviness in the pit of her stomach and especially after meals. Her appetite was fair. She suffered with constipation, which, if not corrected, aggravated the above symptoms.

Physical examination revealed a white cachectic female about sixty years old with deeply jaundiced sclerae and skin. Teeth were false, tonsils atrophied, pupils reacted to light and accommodation. Thorax very thin, ribs prominent, breasts atrophic, flabby, and contained no tumors. Lungs negative. Cardiac impulse in fifth interspace, rate regular, no arrhythmia or murmurs. Blood-pressure, 115/70. Abdomen somewhat distended and tympanitic. Slight rigidity and marked tenderness in upper right quadrant. Gall-

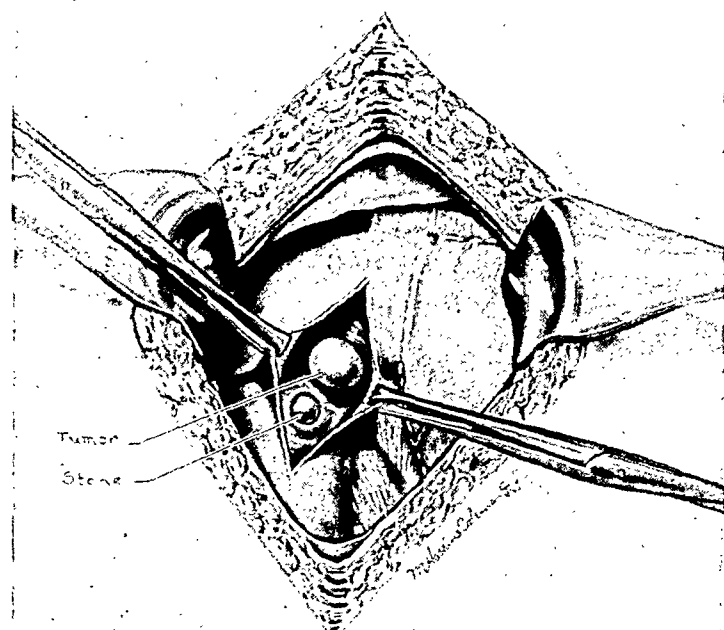


FIG. 1.—Case II. Drawing showing appearance of tumor at operation and stone presenting at opening of common duct into the duodenum.

bladder could not be palpated. No hernia or abdominal masses. Spine flexible and not tender. Extremities were negative and reflexes were non-pathologic. Hemorrhoids present.

Laboratory reported hæmoglobin 52 per cent., red cell count 3,230,000, leucocytes 10,600, of which 65 per cent. were polymorphonuclears, 18 per cent. small mononuclears and 16 per cent. eosinophiles. Coagulation time three minutes and Wassermann negative. Urinalysis showed a trace of albumin, hyaline and granular casts.

Diagnosis: (1) Stone in common duct. (2) Chronic nephritis. (3) External hemorrhoids.

Patient was put on a pre-operative treatment of rest in bed, regulation of bowels, proper diet, hydrotherapy, and calcium lactate gr.  $\bar{x}\bar{x}$  t.i.d. for a week.

September 19 through a right rectus incision a biliary calculus the size of an English walnut could be palpated behind the head of the pancreas at the lower end

## NOTE ON BENIGN TUMORS OF THE DUODENUM

of the common duct. In addition to this a small movable mass could be felt within the lumen of the duodenum. As the stone in the common duct seemed impacted in the ampulla of Vater it was thought best owing to the presence of the tumor within the duodenum, to do a trans-duodenal removal of the stone, and in this way also make the tumor accessible.

On opening the duodenum a small pedunculated tumor about the size of a filbert could be seen attached to the duodenal wall about a quarter of an inch above the orifice of the common duct. (Fig. 1.) By stretching the duct the stone was easily removed. The pedicle of the tumor was then ligated and the tumor removed. The incision in the duodenum was closed with three rows of catgut sutures, and the abdominal wound closed without drainage.

Patient reacted well, her jaundice gradually disappeared and was entirely absent when discharged three weeks later.

Pathologic report of duodenal tumor: "Body of tumor consists of fibrous tissue and blood-vessels. There are patches of round-cell infiltration. The surface is covered by simple columnar epithelium arranged as gland tissue." Diagnosis: Adenoma.

# PANCREATIC LITHIASIS\*

By HOWARD R. HARTMAN, M.D.

OF ROCHESTER, MINN.

FROM THE SECTION ON MEDICINE OF THE MAYO CLINIC

SISTRUNK, in 1921, reported four cases of pancreatic stone in which operation had been performed at the Mayo Clinic, and discussed some of the etiologic factors of the disease, its symptoms, the surgical aspects, and apparent association with diabetes, and the physical properties of the stones. Seeger, in 1925, reported an extensive search of the literature in which he found only 100 cases, one of which was his own. He reviewed the literature and analyzed the symptoms in twenty-two cases.

Pain was of a variable character, constant, intermittent or colicky, with radiation in various directions. Glycosuria occurred only twice, and because others had found it more frequently, he considered it a late complication. Urgent early morning diarrhoea was sometimes encountered with a fatty pancreatic type of stool. Jaundice was not uncommon. He emphasized the difficulty in making a diagnosis even after exploration. In three cases the Röntgen-ray revealed these stones of calcium carbonate.

The articles by Sistrunk and Seeger cover the subject thoroughly. Seeger abstracted twenty-two case histories which included Sistrunk's four cases. A summary of the abstract is as follows:

Pain was not mentioned in three cases, was noted as absent in two, mentioned in six, called severe in ten, and radiated to the back in nine. The pain was situated in the epigastrium or hypochondriac areas with one exception, when it occurred in the left lateral area with downward radiation. Jaundice was not spoken of in six, absent in nine, and was noted in seven; in three cases it was severe.

Gall-stones were not mentioned in five cases, were noted absent in fourteen, and present in three. Glycosuria was present in two cases, was noted absent in fifteen, and not mentioned in five. Loss of weight was not mentioned in fourteen cases; moderate loss was noted in five, and marked loss in three. Vomiting occurred in two cases. Diarrhoea of pancreatic type was not mentioned in fourteen cases, was absent in four, and present in four. Since Sistrunk's report there have been four cases of pancreatic stone demonstrated at operation at the Mayo Clinic. There were five other cases in which pancreatic stone was suspected clinically but not confirmed by operation or Röntgen-ray. These cannot be considered as cases of pancreatic stone.

## REPORT OF CASES

CASE I.—A school girl, aged twenty, came to the Mayo Clinic in May, 1925, because of weakness, palpitation, and shortness of breath, which had lasted three years. She had had influenza in 1920 and repeated sore throat. Her sister had heart disease. In

---

\* Submitted for publication, October 13, 1925.

## PANCREATIC LITHIASIS

1922, the patient noticed a rapid action of the heart. Tonsillectomy was performed, and she was somewhat better, but the palpitation returned. The thyroid gland was partially resected in 1923. Weakness kept her in bed for five months after this operation. The pulse rate diminished somewhat after that but any exertion brought on palpitation and dyspnoea. In 1924, she was put on digitalis and continued this medication until the time of admission to the clinic. There was no history of pulmonary disease, or oedema. She had complained of pain in the joints and muscles for two months before admission.

At the time of admission the systolic blood pressure was 102 and the diastolic 76, the pulse rate 84, and the temperature 99.2. The precordium was retracted and there was a systolic murmur.

The urine and blood were normal. The blood count was normal and the blood Wassermann reaction negative. The gastric content was normal and roentgenologic examinations of the chest and stomach were negative. The basal metabolic rate varied between +1 and +8. The impression was that cardiac neurosis was the predominant symptom.

This opinion was concurred in by two consulting physicians. While under observation the patient developed periodic and increasingly severe pain high



FIG. 1.—Multiple shadows to the right of the first lumbar vertebra, believed to be caused by stones in the pancreas.

in the epigastrium, with vomiting. The leukocytes numbered 19,600. The initial attack was preceded by slight pain and soreness in the upper abdomen for two days. The high situation of the pain, with a tendency to locate in the right chest, and between the shoulder blades, pointed to disease of the gall-bladder. The temperature was normal. June 2, tenderness was noted at McBurney's point, and again on June 5. The temperature was 98°. Operation on the appendix was advised. No jaundice occurred. June 12 the abdomen was explored through the right rectus. The appendix appeared to be quite normal. A tumor, 6 cm. in diameter, was found in the transverse mesocolon at a point about midway between the middle of the transverse colon and the hepatic flexure. The tumor did not appear to be connected with the bowel. When an attempt was made to remove a portion of it for microscopic examination, it shelled out easily. It was traced back toward the head of the pancreas to which it seemed to be attached. It was suspected that the long neck which ran back toward the pancreas

was pancreatic tissue. A specimen was removed and pronounced pancreatic tissue by the pathologist. The mass was then looked on as being a possible accessory pancreas. The long neck was cut off at a point corresponding to the head of a normal pancreas. The patient apparently had definite pancreatitis. The pancreas was hard and nodular, but small. The tissue removed was an elongated mass, with a globular end, made up of pancreatic tissue and ducts, filled with many pancreatic stones, the largest 4 mm. in diameter, and the smallest like sand. There was a small cyst in the globular end of the mass, which also contained pancreatic stones.

Just before operation the patient's temperature had suddenly risen to  $101^{\circ}$ , and following operation it was  $102.5^{\circ}$ . The temperature was normal again on the third day after operation. There was no record of pyrexia during the next three weeks. After that spells occurred occasionally, with a temperature of  $99.6^{\circ}$ , median abdominal soreness, no appetite, and mild pain in the back. There was no jaundice or diarrhœa. The bowels were costive. In the past, more than at the time of examination in the clinic, the stools had been light colored and greasy-looking. Fats never caused inconvenience and a great deal of cream and butter was eaten. After preparing the patient by withholding food for twelve hours and complete evacuation of the bowels by means of cathartics and enemas, röntgenograms taken after the operation showed multiple shadows in the right side, opposite the first lumbar vertebra (Fig. 1). Because stones had been found in the accessory pancreas these shadows were attributed to pancreatic calculi.

CASE II.—A woman, aged thirty-three, had complained for seven years of a dull soreness in the epigastrium, worse one-half hour after meals, without associated gastric or other symptoms except a low abdominal pain on stooping, which had troubled her for the last three years. There were no irregularities of the bowel. Her weight was normal. The systolic blood pressure was 110, the diastolic 68, and the pulse rate 80. A pelvic tumor was found. The usual test of the urine and blood were negative. An operation for excision of the pelvic tumor and exploration of the upper abdomen was advised. The right tube and dermoid cyst of the right ovary were removed. Stones were palpated in the head of the pancreas. At a second operation cholecystectomy was performed for relief from a moderately severe chronic catarrhal cholecystitis, without stones. The head of the pancreas was full of stones. Only those easily accessible were removed. The immediate post-operative convalescence was normal but there was no record of later events.

CASE III.—A man, aged forty-five, had complained of stomach trouble for three years, with a dull aching in the epigastrium occurring from immediately after meals to three hours afterward, not altered by the ingestion of food or soda. He had had trouble constantly since its inception except for occasional periods of one or two days. There was no severe pain or jaundice. Recently, after nausea, he vomited "coffee grounds" and red blood in the early morning. Following gonorrhœa three years before, he had complained of frequent urination and dysuria.

The physical examination was negative except for moderate epigastric and low right abdominal tenderness. The systolic blood pressure was 140, the diastolic 75, and the pulse rate 72. The usual tests of the urine and blood were negative. A deformity of the duodenum was seen by the Röntgen-ray, and ulcer was suspected.

At operation the stomach was found to be enlarged to twice its normal size, but there was no evidence of an ulcer. At the ligaments of Treitz, a calcified, irregular mass 2.5 cm. in diameter was found in contact with the pancreas. The mass appeared to be a calcified gland or coalesced pancreatic stone which had attempted to perforate the pancreas. It was excised. Marked hepatitis was found and cholecystectomy was performed. The hepatitis was of a degree sufficient to explain the gastric hemorrhage. In the pathologic laboratories no final opinion could be expressed and the report was "stony material from region of pancreas; chronic catarrhal cholecystitis; thick dirty bile." The patient convalesced uneventfully.

## PANCREATIC LITHIASIS

CASE IV.—A man, aged forty-five, gave a classical history of duodenal ulcer, without any complications, extending back eight years. Aside from mild epigastric tenderness the physical examination was negative. The systolic blood pressure was 154, the diastolic 92, and the pulse rate 72. The usual tests of the blood and urine were negative. Gastric analysis showed a total acidity of 72, free hydrochloric acid 54, and the röntgenogram depicted the ulcer, which was also found at operation. Gastroenterostomy was performed, and a stone 1 cm. in diameter was removed from the lower edge of the body of the pancreas.

The patient has not been heard from since his dismissal. This pancreatic stone probably caused no symptoms.

## BIBLIOGRAPHY

- <sup>1</sup>Seeger, S. J.: Pancreatic Lithiasis. *Surg., Gynec. and Obst.*, 1925, vol. xl, pp. 841-846.
- <sup>2</sup>Sistrunk, W. E.: The Surgical Removal of Pancreatic Stones. *ANNALS OF SURGERY*, 1921, vol. lxxiv, pp. 380-384.

# THE RELATION OF TOTAL AND POLYMORPHONUCLEAR LEUCOCYTE COUNTS IN CHRONIC APPENDICITIS

By WILLIAM C MENNINGER, M D

OF TOPIKA, KANSAS

AND

HALL G HOLDER, M D

OF SAN DIEGO, CAL

FROM THE SECOND (CORNET) SURGICAL DIVISION, BELLEVUE HOSPITAL, NEW YORK CITY

RECENTLY a study was reported on the clinical significance of the relation of the total and differential leucocyte counts in 309 cases of acute appendicitis,<sup>1</sup> with a discussion of the literature on the subject. At that time, no reference was made to this relationship in chronic appendicitis. The present study is based upon ninety-three cases of so-called (and so classified) chronic appendicitis. Gibson's "standard chart" is again used for the analysis.

To review briefly, Sondern,<sup>2</sup> in 1905, suggested that the degree of leucocytosis indicated the amount of body reaction and the degree of polynucleosis indicated the severity of the pathological process, while the most information could be gained by a relationship ratio between these two. Gibson<sup>3</sup> immediately applied the idea clinically. In his application of Sondern's principles, Gibson devised a "standard chart," on which he could portray the relationship of leucocytosis and polynucleosis. He takes as the normal extreme white count 10,000 and the normal extreme polymorphonuclear percentage as 75. The total white count is charted on the left side of the chart and the percentage of polymorphonuclears on the right side, with a rise of one per cent in polymorphonuclears with each increase in the total white count of 1000 cells. Hence 10,000 is connected with 75 per cent by a horizontal line, 15,000 with 80 per cent, 20,000 with 85 per cent, etc. With a proportional increase in these two factors, a horizontal line results, with a low total white count and a high percentage of polymorphonuclears, a rising line, and with a high total count and a low percentage of polymorphonuclears, a falling line. Hence applying Sondern's principle, a rising line means a relatively poorer body resistance with a more severe inflammatory condition, and hence a more guarded prognosis. And conversely, a falling line portrays a proportional good resistance with a less severe infection, and so a better prognosis.

In the analysis of this series, the term "resistance index" is used, expressed in a minus or plus figure. It refers to the disproportion ratio between the leucocytosis and polynucleosis. When there are 10,000 leucocytes and 75 per cent polymorphonuclears, there is a normal relationship, and these two figures are connected on Gibson's chart by a horizontal line. Connecting a count of 11,000 leucocytes with 75 per cent polymorphonuclears

## LEUCOCYTE COUNTS IN CHRONIC APPENDICITIS

gives a falling line, and using 1000 cells as a unit, the resistance index in such an instance is expressed as a minus one. In a count of 10,000 leucocytes and 76 per cent polymorphonuclears, there is a rising line connecting the two figures, and the resistance index is expressed as plus one

*Present Work*—The aim of this study of the leucocyte counts in chronic appendicitis was to add further evidence to the conclusions made from the study of acute cases that the best resistance, as indicated by the resistance index, is offered by the individual against the less severe pathological process, and that the greatest aid to be obtained from a pre-operative blood count as to indication for operation, is the relationship of the total leucocyte count to the percentage of polymorphonuclears.

The cases studied are classified only as to the microscopical section diagnosis, all of them having shown the clinical picture of so-called chronic appendicitis. The cases presented were chosen from a relatively large number of cases, but for lack of microscopical diagnosis or blood count, complicating conditions, and other reasons, only ninety-three were found satisfactory.

In the ninety-three cases in which total leucocyte counts were made, the average count was 10,513, with extremes of 28,000 and 4000. The differential count as made in 87 of these cases, shows an average of 70.5 per cent polymorphonuclears, with extremes of 87 and 47 per cent. The lowest average total white count occurred in the cases showing no microscopical pathology, being 8968, and with also the lowest differential count, with 66.5 per cent polymorphonuclears.

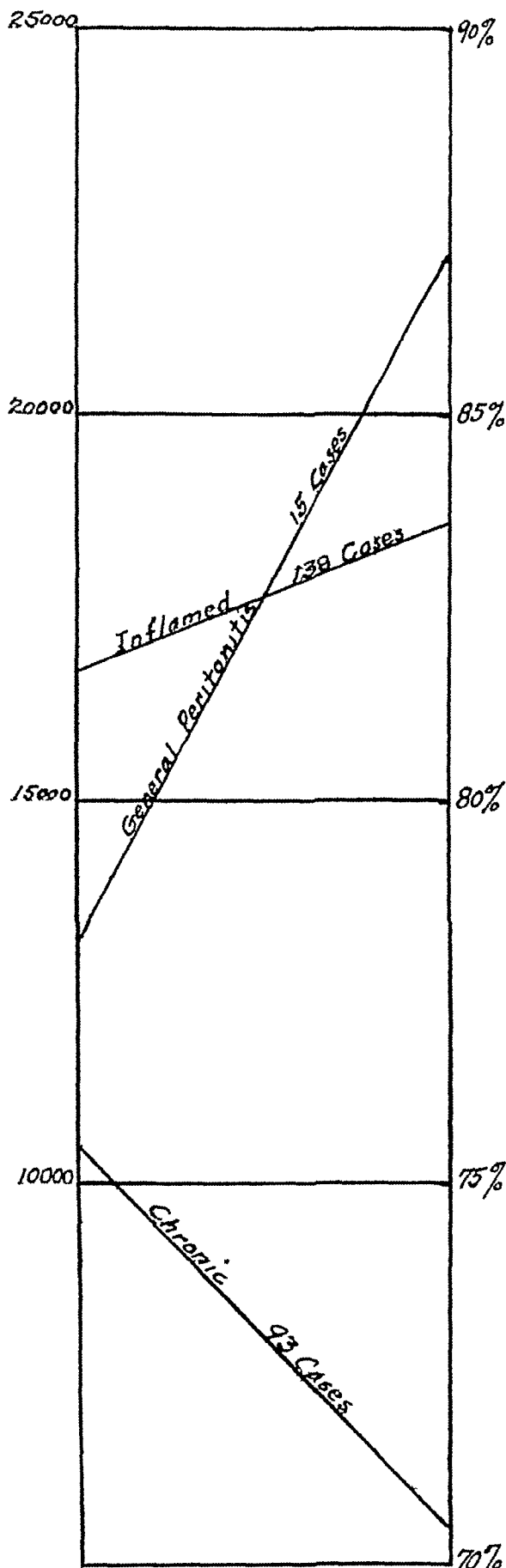


FIG. 1.—Resistance line contrasting chronic appendicitis with acute appendicitis and with general peritonitis.

The number of cases in each



# MENNINGER AND HOLDER

TABLE I

*Total Leucocyte and Polymorphonuclear Counts in Various Pathological Groups of Chronic Appendicitis*

Pathology	Number of cases with W B C count	Average leucocytosis	Extremes of leucocytosis	Number of cases with differential	Average per cent polymorphonuclears	Extremes of polymorphonuclears per cent	Resistance index
Normal	26	8968	{14400 4000}	25	66.5	{81.0 54.0}	-7.5
Hyperplastic	17	9694	{12800 6000}	17	73.6	{87 51}	-1.0
Catarrhal	9	9648	{15000 7000}	7	71.3	{81 58}	-2.3
Atrophic	5	14560	{22000 9200}	5	74.6	{83 62}	-4.8
Sclerotic	32	11443	{28000 5000}	29	70.9	{87 47}	-5.5
Suppurative	4	13475	{21000 8100}	4	74.7	{82 60}	-3.8
Total Cases	93	10513	—	87	70.5	—	-5.0

group (normal, hyperplastic, catarrhal, atrophic, sclerotic, suppurative) with the average total and neutrophilic leucocyte counts is shown in Table I

The resistance index of the total number of cases is minus five, and when charted shows a steeply falling line. It is shown graphically on the chart, and there can be compared with the rising line in 138 cases of inflamed (acute) appendicitis and the steeply rising line in 15 cases of general peritonitis associated with appendicitis, reported in the previous study. In the 63 cases of chronic appendicitis reported by Pease,<sup>1</sup> the resistance index is a minus 8.9, and in Fowler's<sup>2</sup> 33 cases, it is minus 7.3

## SUMMARY

In acutely inflamed cases, there is a plus resistance index figure, which increases with the severity of the process. The data for chronic cases here presented, shows a minus resistance index figure, which we feel further supports the principle that the total leucocyte count represents the body reaction and the polymorphonuclear count expresses the severity of the pathological process. The ratio between these, as expressed by the resistance index, is a minus figure in cases with chronic pathological changes associated with chronic symptoms clinically, but becomes a plus figure in cases with acute pathological changes, associated with acute symptoms clinically. The figure continues to rise as the severity of the process increases.

The writers wish to express to Dr. H. E. Santee, Director of the Second Surgical Division, their appreciation of the courtesy in affording the opportunity of reporting the above cases.

# LEUCOCYTE COUNTS IN CHRONIC APPENDICITIS

## REFERENCES

- <sup>1</sup>Menninger, W C, and Heim, H S The Clinical Significance of the Relation of Total and Differential Leucocyte Counts in Acute Appendicitis ANNALS OF SURGERY, vol lxxx, pp 915-931, December, 1924
- <sup>2</sup>Sondern, F E The Present Status of Blood Examination in Surgical Diagnosis Med Rec, vol lxxvii, pp 452-455, March 25, 1905
- <sup>3</sup>Gibson, C L The Value of the Differential Leucocyte Count in Acute Surgical Diseases ANNALS OF SURGERY, vol xliii, p 485, April, 1906
- <sup>4</sup>Pease, G N The Value of the Leucocyte and Differential Counts in Appendicitis ANNALS OF SURGERY, vol xlix, pp 385-391, 1909
- <sup>5</sup>Fowler, R H The Relation of the Lesion in Appendicitis to the Leucocyte Count Surg, Gyn and Obs, vol vii, pp 308-316, 1908

# TECHNIQUE FOR THE REMOVAL OF HEMORRHOIDS\*

By LOUIS A. BULL, M.D.

OF ROCHESTER, MINN.

FROM THE SECTION ON PROCTOLOGY OF THE MAYO CLINIC

I WISH to describe an operation for hemorrhoids which is not new or unique, but which eliminates certain undesirable features that are usually associated with this operation.

*Preparation of the Patient*—No supper is allowed on the night before the operation, and a dose of castor oil is given. Three hours before the operation the bowel is irrigated with soap suds and warm water, until the water returns unstained, and 2 ounces of witch hazel are injected and allowed to remain until just before the operation, when the fluid is drained through a rectal tube. This is all the pre-operative preparation necessary other than the usual shaving of the perianal skin and the administration of 0.16 gram of morphin sulphate hypodermically.

The patient is placed on the operating table in the Kraske position preliminary to giving a sacral anæsthetic, and allowed to remain in the same position during the operation. A pillow is placed under the pelvis. We are all familiar with the bulging and distortion around the anus produced by the exaggerated lithotomy position, especially when the patient is under the influence of a general anæsthetic. This undesirable feature is eliminated and the position has the advantage over the Sims' position of giving the assistant a more accurate view, and access to, the operative field.

*Operation*—The operation is begun by dilating the anus. Divulsion is not resorted to except in cases in which there is anal spasm or actual contraction. Divulsion is unnecessary in performing the average hemorrhoidectomy. It distorts the anus and produces numerous superficial cracks which harbor infection. It also causes much contusion and hemorrhagic extravasation into the muscles. The contention that divulsion puts the anus at rest and thereby excludes the possibility of post-operative pain probably holds good for the first few hours after the operation, but the muscles soon regain sufficient of their former tone to contract again on the raw surfaces. The effects of the over-stretching are, unfortunately, much more enduring and more harmful. The contusion, thrombosis and infection of the numerous superficial cracks which are caused by the divulsion, produce excessive discomfort, make it necessary to catheterize more frequently, and delay healing materially. Therefore, the anus is dilated just enough to expose the hemorrhoids and to avoid breaking the skin of the anal orifice whenever possible. Through an anoscope a piece of gauze is inserted and pulled through the anus (Fig. 1a). This exposes the hemorrhoids and gives a very accurate idea of the amount of prolapse induced by defecation. This has an important bearing on the amount

---

\* Submitted for publication, August 11, 1925.

## THE REMOVAL OF HEMORRHOIDS

of tissue to be removed. Four retracting clamps are then applied to the anal margin (Fig 1b). After grasping the hemorrhoid and crushing it with a strong crushing clamp made especially for the purpose, or an ordinary heavy Kelly clamp, a suture is tied at the upper end of the hemorrhoid (Fig 1c). The excess mucous membrane and veins are cut away and the suturing continued (Fig 1d). After tying, the ends of the suture are left long. The protrusion externally is then grasped and cut around (Fig 2a). The veins



FIG 1 —Exposure and removal of internal hemorrhoids

are dissected from the sphincter, crushed in a curved clamp, cut away and the suturing continued (Fig 2b). If the needle is carried too deeply into the muscle, pain and muscle spasm are the result. The wound margins now fall together and no further sutures are necessary (Fig 2c and d). When there are no external or marginal varicosities the operation is completed by omitting the steps depicted. A strip of 1 inch iodoform gauze, about 3 inches long and in four layers, inserted through an anoscope, completes the operation.

*Post-operative Care* —When the patient is returned to his room he is given 0.16 grain of morphin sulphate hypodermically, and from three to five hours later, 30 grains of bromids. A liquid diet is given, and on the day following the operation the care of the wound is begun. The post-operative management is the most important part of the entire procedure, and many troublesome complications are avoided by strict attention to it. On the morning of the second day the dressing is removed and the anal margins cleansed with



FIG. 2.—Removal of external hemorrhoids

with hazel, boric acid, or some other mild antiseptic solution. The margins of the wound are swabbed with small cotton applicators and a dry dressing powder applied. A small piece of cotton or gauze is sufficient to protect the wound. This is done daily for four days and the patient remains in bed. On the night of the fourth day an ounce of mineral oil is given and a general diet ordered. On the next morning the bowel is irrigated with hot water ( $110^{\circ}$ ) during which time the iodoform gauze strip comes away. The irrigation should be thorough and continued until the water returns clear. After this

a perforated irrigating tip, 0.5 cm in diameter, is inserted through the anus, and a 20 c.c. syringe is used to irrigate the wound margins with witch hazel. This is followed by thorough and careful swabbing and drying of the wound, and the application of dry powder. If there is swelling, pain or other evidence of unusual infection, hot fomentations should be applied and changed hourly. On the sixth and seventh days the bowels do not move as a rule, and it is only necessary to irrigate the anus with witch hazel and apply dry dressings. If they should act, however, hot irrigation is carried out, and this procedure should follow every stool for three weeks after the operation, even after the patient has left the physician's care. It is not necessary to give opium to "confine the bowels", simple instructions to the effect that it is undesirable to have bowel movements during the first four days after operation are usually sufficient.

After the seventh day, proper foods and mineral oil keep the bowels moving daily, and the treatment is the same as that carried out on the fifth day. Digital examination is made occasionally during the second week, and the patient can be dismissed permanently in from twelve to sixteen days. At this time he is instructed to take a hot enema after each stool for a week.

A relatively poor operation can be made to produce a very satisfactory result if the proper care is given to the wounds after the operation is completed. On the other hand, a splendid operation may result disastrously, and frequently does, because no attention is given to the post-operative care. The care of wounds after hemorrhoidectomy, or more accurately, the lack of care of these wounds, is in striking contrast to the vigilance of surgeons in their care of wounds following all other types of surgery. Such distortions as tags and strictures are not due to the removal of too much or too little tissue, or other faulty technic, but they are the result of progressive slough occurring when healing should be uninterrupted.

Physicians are in the habit of minimizing the importance of rectal diseases, and patients are usually told that it is only a simple matter and that they will be up and around in a few days after the removal of hemorrhoids. No wonder there is dissatisfaction at the disillusionment, as days of discomfort drag on into weeks. We should offer more consideration to patients with all rectal complaints. We should examine them early, no matter how trivial the signs. Nowhere is the golden rule more applicable.

## BILATERAL DUPLICATION OF RENAL PELVES AND URETERS<sup>1</sup>

By HENRY W E WALTHER, M D  
OF NEW ORLEANS, LA

THE literature on duplication of the ureters and renal pelves has been thoroughly covered in recent years by the excellent contributions of Mertz,<sup>1</sup> Harpster, Brown and Delcher,<sup>2</sup> and Braasch and Scholl. Mertz rates the frequency of bilateral duplication of ureters and renal pelves as 27 per cent of all anomalous conditions met with in the upper urinary tract, Braasch places the figure at 6 per cent, and Harpster gives 10 per cent. This variance Braasch attributes to the failure on the part of the profession to report these interesting abnormalities.

Of instances of bilateral duplication of ureters and renal pelves, Harpster was able to collect 40 from the literature, Braasch added 9, Eisendrath and Phifer<sup>4</sup> cite one case, and the patient herewith reported brings the total to 51. Few cases have been diagnosed pre-operatively. Before the use of the cystoscope and the X-ray the reason was obvious. But to-day the failure to detect these anomalies must rest with the cystoscopist. Too hurried an examination of the bladder mucosa, the failure to employ indigocarmine where double ureteral ostia are suspected and the omission of urograms undoubtedly account for many of these cases going unrecognized. The condition is of interest clinically because of the frequent pathology encountered. In these cases it is not uncommon to find infected urine from only one of the numerous ureteral orifices, the others giving urine free of pus and bacteria.

To the literature already accumulated we add the following history of a recent case under our observation.

Mrs. M. W., age sixty-five, native of Louisiana, seen in consultation with Dr. W. J. Otis. Her complaint was dull, aching pain in the epigastrium which had been present for eight months, pain under right shoulder blade, and on the inner side of both thighs but more severe in the left. She had slight burning with frequency of urination. The family history was irrelevant.

About a year ago she was operated for gall-stones but continued to suffer with the same symptoms as before. After a lengthy convalescence she was discharged from the hospital. She returned home but soon the pains became unbearable with the additional discomfort of a post-operative hernia. She was admitted to the Charity Hospital and operated for hernia, adhesions and appendix. The second operation did not give any relief from pain. She now has fullness and feeling of being bloated after eating. Bowels move about once a week. For the past year the burning and frequency of urination has been steadily getting worse. No hematuria. Passes urine every two hours during the day and about six times every night. After the bladder has been emptied there is a dull pain over the suprapubic area. No headaches nor is she nervous. Cannot sleep. Palpitation on exertion with dyspnoea. Has been married twice, first husband died of apoplexy, second from heart disease. She has had no children nor miscarriages, menopause fifteen years ago.

---

<sup>1</sup> From the Fifth Urological Service of the Charity Hospital of New Orleans

Physical examination reveals a well-developed adult female, fairly well nourished, skin pale, flabby, damp and cold. Hair gray, dry, brittle. Eyes react to light and accommodation. Ears negative, nose negative. Chest symmetrical, expansion equal, good, mucous râles over lower lobes, slight dulness over base of both lungs. Mitral murmur transmitted to axilla. Some enlargement of cardiac area of dulness. Abdomen shows right rectus and low median scar. Extreme tenderness over entire abdomen. No masses can be felt. Liver palpable. Extremities negative, genitalia negative, vaginal examination negative. Blood-pressure systolic 140, diastolic 90. Urinalysis no residual, cloudy in both glasses, heavy albumin no sugar, hyaline casts, pus two plus, colon bacilli two plus. Two-hour 'phthalein first, 20 per cent, second, 15 per cent, total 35 per cent. Blood chemistry sugar 87, creatinine 184, non-protein nitrogen 35, urea nitrogen 17. X-ray of chest and gastro-intestinal tract negative.

June 26th cystoscopy under local anaesthesia. Urethra negative, bladder congested, ureteral orifices normal in appearance. After passing left ureter catheter a second orifice was noted about 1 cm above and to the outer side. Both left ureters were easily catheterized with 6 F catheters to kidney pelves. The right orifice was easily found and catheterized, a careful search failed to locate a second opening on this (right) side. Urines collected and urograms made which showed complete duplication of ureters and kidney pelves on left side. The urine

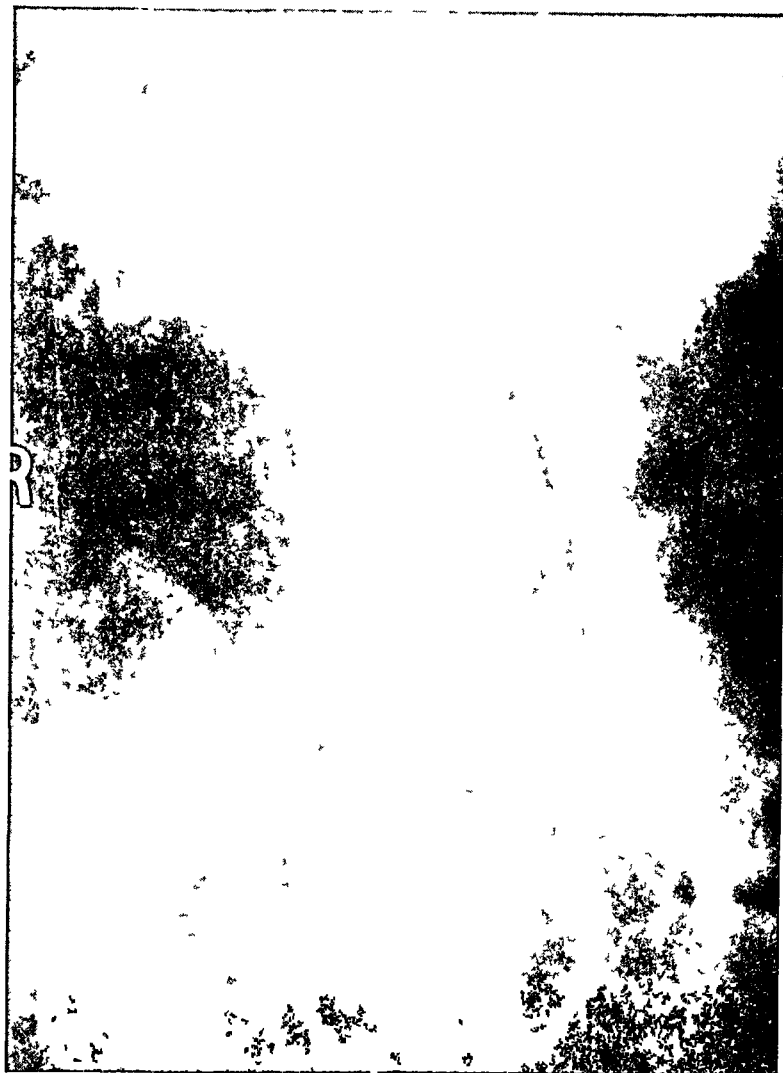


FIG 1 —Urogram showing bilateral duplication of renal pelves and ureters

from the upper pelvis was negative, from the lower pus two plus and colon bacilli two plus. Urine from the right kidney was negative.

July 2 at cystoscopy indigocarmine was given intravenously and in four minutes was seen coming from both orifices on the left side, appeared from the right in six minutes. The two left ostia were catheterized with 5 F catheters through the operating canal of a universal Bueiger cystoscope. The orifice on the right was then catheterized with a 6 F catheter through the left catheterizing canal. Dye was then found to be coming from above this right catheter and after much difficulty a second right orifice was located and catheterized with a 5 F catheter *via* the right catheterizing canal. Urograms were made with a 25 per cent sodium iodid, a print of the film is illustrated herewith in Fig 1. The lower catheter on the right side became blocked with a blood clot and no iodid solution could be forced through. Urinalysis of specimen from upper pelvis on right was negative—as had been previously demonstrated with urine from



lower pelvis on this side Lower left pelvis lavaged with 1 per cent silver nitrate solution

July 17 cystoscopy and left ureters catheterized and urines collected 'Phthalein given intravenously, appeared from lower left ureter in 7 minutes and in 15 minutes excreted 7 per cent From upper left ureter 'phthalein appeared in 10 minutes and in 15 minutes excreted 5 per cent Lavage of lower pelvis with 1 per cent silver nitrate solution Urine shows less pus and bacteria and patient feels better

July 26 cystoscopy and indigocarmine used to find right orifices Dye appeared in 2 minutes from upper right ureter ostium and in 3 minutes from the lower Both right ureters catheterized and urines collected 'Phthalein intravenously appeared in 4 minutes from the upper right ureter and excreted 9 per cent in 15 minutes, dye appeared from lower right ureter in 5 minutes and in 15 minutes excreted 6 per cent Urines negative

August 1 patient refuses further treatment and is gradually getting worse On August 13 she died

Autopsy showed marked sclerosis with calcified areas throughout aorta, enlarged heart with fatty degeneration of the musculature, mitral regurgitation Lungs show passive congestion Slight sclerosis of the liver Many adhesions in gall-bladder region, gall-bladder has been removed The omentum is bound down by dense bands of adhesions The entire abdominal cavity has the appearance of former general peritonitis Kidneys are very large, light in color, with two ureters from each kidney to bladder The ureters on left side enter bladder separately while on the right they appear to be joined in a common sheath about three inches above the bladder wall Ovaries enlarged and cystic, multiple intramural fibroids of uterus Appendix has been removed Clinical diagnosis acute parenchymatous nephritis Pathological diagnosis arterio-sclerosis, myocardial degeneration, chronic nephritis acute hypostasis of both lungs

The specimen showing the bilateral duplication of the ureters and renal pelvis was exhibited before the section on urology, Southern Medical Association, at their last annual meeting

#### REFERENCES

- <sup>1</sup> Mertz, H O Bilateral Duplication of the Ureters with a Compilation of Recorded Cases Urol and Cutan Rev, 1920, vol xiv, pp 636-642
- <sup>2</sup> Harpster, C M, Brown, T H, and Delcher, H A Abnormalities of the Kidney and Ureter Jour Urol, 1922, vol viii, pp 459-490
- <sup>3</sup> Braasch, W F, and Scholl, A J, Jr Pathologic Complications with Duplication of the Renal Pelvis and Ureter (Double Kidney) Jour Urol, 1922, vol viii pp 507-546
- <sup>4</sup> Eisendrath, D N, and Phifer, F M Bilateral Heminephrectomy in Bilateral Double Kidney Jour Urol, 1925, vol xiii, pp 525-535

PREHERNIAL LIPOMA  
BY LEIGH F. WATSON, M D  
OF CHICAGO, ILL

Most so-called fatty hernias are simply isolated masses of fat, unattached to a sac, and I believe they should be called hernias only when they are accompanied by a peritoneal sac

Lipomata are frequently found in the inguinal canal along the cord. Their lower portion is usually attached to the sac, and their upper portion is continuous with the preperitoneal fat at the internal ring.

Fatty hernias in the inguinal canal can be seen as soon as the aponeurosis of the external oblique is incised. The mass is often lobulated and slightly vascular and it is sometimes surrounded by a thin cellular fascia which separates it from the other structures.

A lipoma in the inguinal canal that is adherent to the sac or cord is almost always attached to the preperitoneal fat at the internal ring, and by causing a bulging into the canal, favors the development of hernia. The lipomata should always be removed at operation to lessen the danger of recurrence.

Fatty hernias are most often seen in young persons, but strangulation is more frequent in middle life, between forty to forty-five years of age. The peritoneal diverticulum that accompanies a true fatty hernia is usually rigid and inelastic, consequently it cannot hold a hernia and the examining finger enters the diverticulum with difficulty.

Strangulation is very rare. In the beginning of strangulation there is usually only a part of the lipoma beneath the skin in the subcutaneous tissues, and gradually more fat is forced through the hernial orifice by increased intra-abdominal tension or a sudden strain. When the peritoneal diverticulum attempts to pull back the intra-abdominal fat, the mass is caught in the ring, and it may become twisted, its blood supply obstructed, or it may rarely become strangulated.

The mass is seldom larger than a pigeon's egg, and with the onset of gangrene, it turns reddish-brown in color, and has a consistency similar to that of molasses.

Simple lipomas are ordinarily painless and cause no symptoms except the slight discomfort from their presence. When a fatty hernia makes traction on a peritoneal sac, it may produce pain and reflex symptoms which necessitate operative relief. This often happens when the hernia is in the linea alba. Pain is not so uniformly present in the other varieties.

There is generally a history of a fatty tumor having been present for some time before symptoms of strangulation develop. It is exceptional for strangulation to occur with the first appearance of the tumor.

The pain is most marked over the lipoma. The congestion and inflammation in the tumor are responsible for the general symptoms, such as nausea,

vomiting, abdominal distention, partial constipation or obstruction. However, these symptoms are not always present. In some cases the symptoms do not develop for some time after the appearance of the mass, in others, the symptoms are of sudden onset due to torsion or strangulation of the lipoma.

When the lipoma is strangulated it is hard, painful and irreducible and difficult to differentiate from a small strangulated enterocele or omentocoele.

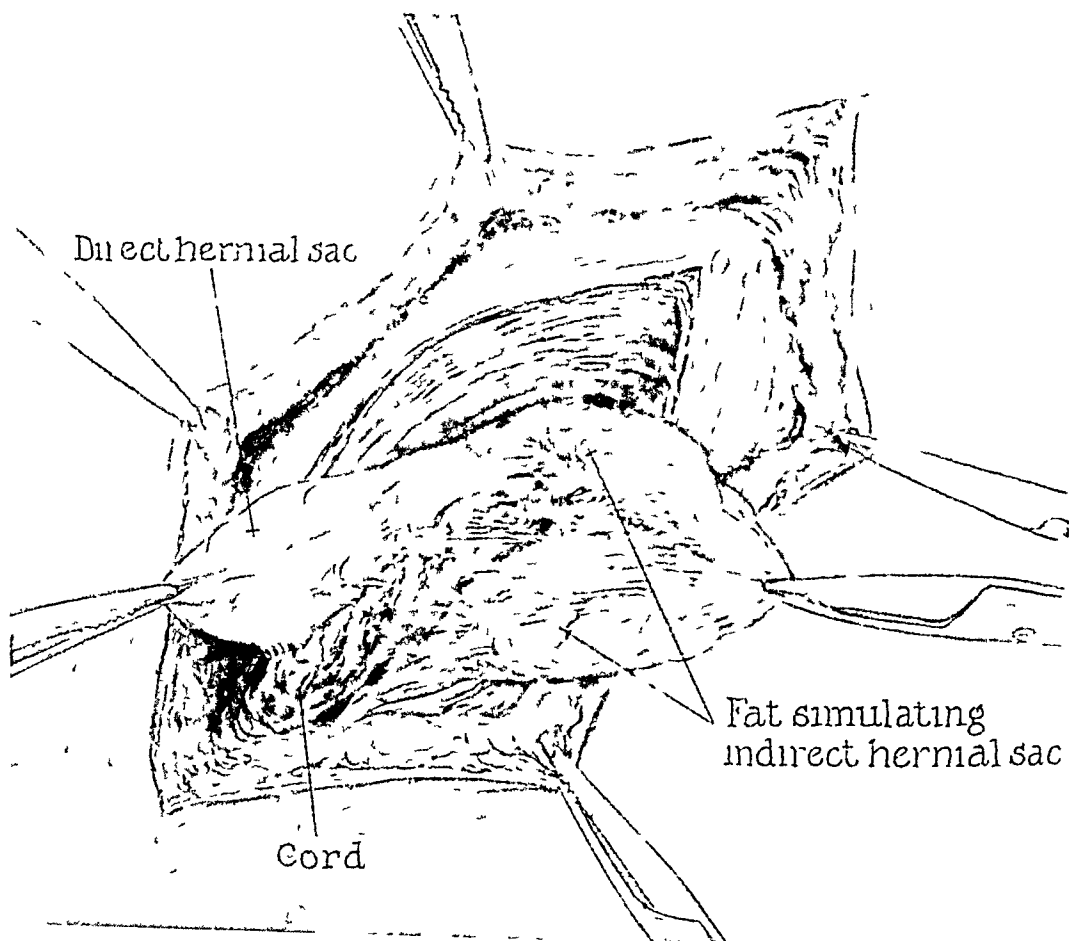


FIG. 1.—Prehernial lipoma complicating inguinal hernia.

In acute strangulation the symptoms develop slowly, usually in from four to six hours, and the typical symptoms are not well defined until about twenty-four hours later.

*Diagnosis*—Diagnosis is most difficult when the tumor appears suddenly after a strain, with pain, more or less nausea, vomiting, abdominal tenderness, and meteorism.

Inflamed or strangulated fatty hernia must be distinguished from reducible, irreducible, and strangulated hernia of the intestine, omentum, or other abdominal viscera. Also from hernial peritonitis, strangulated partial enterocele, hernia of the vermiform appendix, hernia of an epiploic appendix or Meckel's diverticulum, volvulus of the omentum or intestine, strangulation

## PREHERNIAL LIPOMA

of an internal hernia, intestinal obstruction, ectopia testis, epididymitis, orchitis, and adenitis

*Treatment* —Small fatty hernias without symptoms usually do not require treatment. When there is pain or reflex symptoms, operative treatment may be demanded. Large fatty hernias without symptoms may require operation on account of the physical inconvenience they cause, or as a preventive measure against the subsequent development of an enterocele or omentocele.

Before excising the fatty mass the operator must be sure that it consists only of adipose tissue. Injury to the intestine and omentum must be guarded against, and in the femoral and inguinal regions the bladder, appendix, ureter, and a Meckel's diverticulum must be thought of. The peritoneal diverticulum must be entirely removed. After dissecting out and excising the lipoma, the peritoneal and fascial layers are sutured together and the hernia opening carefully closed.

# THE VALUE OF BLOOD TRANSFUSION IN SURGERY OF THE PROSTATE

By AUSTIN I DODSON, M.D.  
OF RICHMOND, VA

FROM THE UROLOGICAL DEPARTMENT OF ST. ELIZABETH'S HOSPITAL

BLOOD transfusion may be of special merit in the treatment of prostatic hypertrophy. These patients have reached the age when recuperation from injury is slow and many are additionally handicapped by anemia and sepsis. By increasing the volume and quality of the blood, thereby improving the general vitality, blood transfusion is a most valuable adjunct to the pre-operative care.

In a series of 147 deaths from prostatectomy collected by J. B. Deaver, hemorrhage and shock occupy second and third places as causes of death. It is to combat these two fatal complications of prostatectomy that blood transfusion is of greatest help. The blood-vessels of many of these old men, because of sclerotic changes, are unable to adjust themselves to the rapid loss of fluid from the vascular system. There results a fall in blood-pressure which, unless the fluid volume is restored and maintained, frequently goes on to complete collapse and death. The volume may be restored by the infusion of saline or glucose solutions with very satisfactory immediate effect. In patients suffering from shock, these solutions—particularly saline solution—seem very rapidly to leak out of the circulation, and their value is often temporary. In hemorrhage these fluids lack the elements necessary to restore the blood cellular loss. They are very effective in combating the immediate dangers resulting from hemorrhage, but the old man is left to meet, in an anæmic condition, such pitfalls as sepsis and pneumonia which often endanger the convalescence of the patient recovering from prostatectomy. We have used 5 per cent glucose solution by the method described by Matas (Matas, Rudolph "The Continued Intravenous Drip," *ANNALS OF SURGERY*, vol lxxix, p 643, May, 1924) with a great deal of satisfaction in several cases. We believe this to be the most desirable means of administering infusions in cases of toxic exhaustion and dehydration and in the treatment of shock and hemorrhage in young and robust patients whose natural recuperative powers can be counted on.

Transfusion of whole blood is, however, the most efficient restorative. It rapidly replaces the lost fluid, improves the quality of the blood, and, by decreasing the coagulation time, is a valuable asset in the control of bleeding. When used by the direct cannula method and when the blood is properly matched, transfusion is free from the disagreeable and sometimes dangerous reactions that often result from the introduction of foreign fluids into the blood. These reactions, while of little consequence in young or robust individuals, are a distinct handicap to the debilitated old men who comprise the

## BLOOD TRANSFUSION IN PROSTATIC SURGERY

prostatic patients needing transfusion. It is for this reason that we have abandoned citrate transfusions. The direct method using the Bernheim cannula has been found most satisfactory, being almost entirely free from reactions and delivering the blood to the patient in its natural state. (Horsley, J. Shelton, Vaughan, W. T., and Dodson, A. I. "Direct Transfusion of Blood," *Arch Surg*, vol. v, pp. 301-313, September, 1922.) In every instance in uncomplicated shock or hemorrhage, the blood-pressure has been rapidly restored and satisfactory recovery has supervened.

Our conclusion as to the value of transfusion of blood following prostatectomy are based on the following seven cases:

CASE I—Mr. W. W., seventy-five years of age, had hypertrophy of the prostate which was cancerous. A suprapubic prostatectomy was performed May 26, 1921. Sixty milligrams of radium were applied through the suprapubic wound and thirty milligrams through the rectum for eighteen hours. Immediately after operation the temperature was normal, pulse 90, and respiration 22. Two hours later the patient began to bleed profusely from the site of operation. His condition rapidly became critical. The pulse-rate increased to 160, and the blood-pressure was 75 systolic, diastolic not obtainable. He was transfused by the direct cannula method. The blood-pressure steadily increased until at the end of fifteen minutes of transfusion, the systolic pressure was 115, diastolic 85. The pulse-rate fell to 120. Following the transfusion there was some bleeding for only a short time. The patient is now symptom-free, four years after the operation.

CASE II—Mr. S. B. G., seventy-seven years of age, was operated upon April 22, 1922, for benign hypertrophy of the prostate by the perineal route. The patient left the table in good condition. Two hours after the operation he was found to be bleeding rather freely, necessitating reinforcing the packing. His pulse at this time was 100 and weak, his systolic blood-pressure was 90, diastolic 55, and the patient felt faint. Direct transfusion of blood was given for twenty-two minutes, after which his systolic blood-pressure was 108, diastolic 60. There was no further bleeding and recovery was uneventful.

CASE III—Mr. J. I. B., seventy-three years of age, was operated upon May 10, 1922, by the perineal route. A moderately large cancerous prostate was removed and sixty milligrams of radium were inserted in the wound and allowed to remain twenty-four hours. He left the table in good condition. His pulse was 118, systolic blood-pressure 130, diastolic 80. Two hours later the systolic blood-pressure had fallen to 95, diastolic 60, and pulse was 100. He was pale and his extremities were cold. There was very little loss of blood. His blood-pressure continued to fall until three hours after operation, when the systolic pressure was 70 and diastolic 20. At the end of a twenty-minute direct transfusion the systolic pressure was 115, diastolic 70. There was no further fall in blood-pressure and he made a satisfactory immediate recovery. He died twelve months later of a recurrence of the cancer.

CASE IV—Mr. R. W. C., sixty-five years of age, was operated upon by the suprapubic method for benign hypertrophy of the prostate, January 16, 1924. The patient left the table in good condition, his pulse 120 and of good volume. He did fairly well for about two hours when his pulse became weak, the systolic blood-pressure 100, diastolic not obtainable. Temporary improvement was obtained by the application of heat and by lowering the patient's head. Four hours after operation, his blood-pressure could not be obtained. After the administration of three grains of caffeine, the systolic blood-pressure was 60, diastolic not obtainable. After direct transfusion for eight minutes the systolic blood-pressure was 90, diastolic 45. He continued to improve, and twelve hours later his systolic blood-pressure was 120, diastolic 60. He was discharged, well, forty-three days after operation.

## AUSTIN I DODSON

CASE V—Mr R B M, fifty-six years of age, was operated upon by the suprapubic method for benign hypertrophy of the prostate, July 19, 1924. The patient left the table in good condition, systolic blood-pressure 132, diastolic 72, pulse 110. Six hours later his systolic pressure was 130, diastolic 80, and pulse 100. The following morning the systolic pressure had dropped to 110, diastolic 74, pulse 60. During the day his blood-pressure continued to fall and pulse-rate increased, until at 7 P.M. the systolic blood-pressure was 88, diastolic 58, and pulse 120. There had been very little bleeding and his haemoglobin was 80. At the end of ten minutes of direct transfusion the systolic pressure was 110, diastolic 58, and pulse 100. Thirty minutes after the transfusion his systolic blood-pressure was 115, diastolic 60. The day following the transfusion his systolic pressure was 122, diastolic 70, pulse 88. His convalescence was uneventful.

CASE VI—Mr S H G, sixty-six years of age, was operated upon by the perineal route, February 23, 1925, for hypertrophy of the prostate which was cancerous. Sixty milligrams of radium were applied in the wound. He left the table in good condition. His pulse was 108, systolic pressure 124, and diastolic 70. The blood-pressure remained the same during the first twelve hours after operation, the pulse increasing to 120. The following morning the systolic blood-pressure was 126, diastolic 58, pulse 140. His temperature was 104, abdomen distended, and he was hiccupping and vomiting. At the end of nine minutes of transfusion the blood-pressure was unchanged, but two hours later the systolic pressure was 130, diastolic 70. This improvement lasted only about five hours, when his blood-pressure began to fall again and he died forty-eight hours after operation, apparently from an overwhelming toxæmia or infection.

CASE VII—Mr A S F, fifty-nine years of age, was operated upon November 19, 1924, for carcinoma of the prostate by the perineal route. He left the table in good condition, with pulse 100, systolic blood-pressure 128, and diastolic 70. About three hours after the operation he began to show a considerable degree of shock, systolic blood-pressure 90, diastolic 50. He was relieved by the administration of 5 per cent glucose solution intravenously, his blood-pressure steadily increasing until at the end of twelve hours his systolic pressure was 120, and diastolic 70. The following day his abdomen became distended and he was greatly distressed by constant vomiting and hiccupping which persisted until his death. During this time his pulse varied from 108 to 120, his temperature was never above 100 and he excreted a satisfactory amount of urine. On the fifth day following operation 5 per cent glucose solution was again given intravenously because of his inability to take fluid in any other way. When he had taken 200 c.c. of the solution he had a chill and the glucose solution was discontinued. Following the chill he was in collapse, systolic blood-pressure 100, diastolic 74, and pulse 140. After a transfusion lasting eight minutes his systolic blood-pressure was 112, diastolic 80, pulse 130. The improvement was only temporary and he died twelve hours later.

All of these patients were below the average as operative risks. The oldest was seventy-seven years old, the youngest fifty-six, and the average of their ages was sixty-eight years. Four had carcinomatous prostates and all of them some degree of arteriosclerosis.

In two cases transfusion was given because of hemorrhage, in two because of shock, and in three because of gradual failure of the circulation and inability to rebound. The four patients transfused for hemorrhage and shock were immediately relieved of their distressing symptoms and made uneventful recoveries. Of the three other patients, one recovered and two died. The patient who recovered showed no serious symptoms before transfusion except a gradual fall of blood-pressure and a feeling of weakness. He was transfused thirty-six hours after operation when his blood-pressure had fallen to 88 systolic, and 58 diastolic. He showed immediate improvement and made

## BLOOD TRANSFUSION IN PROSTATIC SURGERY

an uneventful recovery. Of these five patients, one with a cancerous prostate died twelve months following operation from recurrence of the cancer. The other four, one of whom was operated upon for carcinoma of the prostate four years ago, are now in good health.

The two patients who were not benefited by transfusion had carcinoma of the prostate. In one of these patients (Case VI), sixty milligrams of radium in needles were inserted in the wound for twenty-four hours. He did well for twelve hours, when his pulse-rate began to increase and his blood-pressure gradually to fall. There was also a rise in temperature and he was greatly distressed by persistent hiccough, vomiting and distention. He was transfused twenty-four hours after operation with apparent temporary benefit, but died thirty-six hours later. The other patient showed considerable shock three hours after operation, which was relieved by the intravenous administration of 5 per cent glucose solution. He developed marked distention, and vomited and hiccoughed continuously. Five days after operation he was again given 5 per cent glucose solution intravenously because of his inability to take fluids otherwise. This was discontinued on account of a chill after 200 c c had been administered. A direct transfusion of blood was then given. There was only temporary improvement and he died twelve hours later, apparently a cardiac death.

It is evident from a study of these cases that blood transfusion is not a panacea for all the ills that befall the prostatic patient. The two patients who died gave evidence of a rather profound toxæmia. Both of them suffered from intestinal paresis, accompanied by vomiting and hiccough, and the pulse became rapid within a few hours after each patient left the table and remained so until he died. One of these patients (Case VII) suffered a considerable degree of shock immediately following operation, and although he responded to the intravenous administration of 5 per cent glucose solution, it is possible that a blood transfusion instead would have given him a better chance. It is evident that our faith was too great in expecting benefit from transfusion after the patient was completely exhausted, nor have we a right to expect improvement when the patient has been overcome by a toxæmia or an infection.

Transfusion of blood is of great benefit as a general tonic to the anæmic, debilitated old man during his preparation for prostatectomy and in the treatment of shock, hemorrhage, and the general asthenic state following prostatectomy. The matching with the patient of suitable donors should be a part of the preparation for every prostatectomy.



# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY

*Stated Meeting Held May 13, 1925*

The President, DR WALTON MARIN, in the Chair

### EFFECT OF MIXED TOXINS ON RECURRENT SARCOMA OF THE TESTICLE

DR WILLIAM B COLLY presented a child who had a history of a trauma at twenty months of age, a few months prior to the appearance of a tumor in the left testicle which was first noticed in May, 1917, and which grew to the size of an orange in three weeks. Removal of the testicle at this time was done by Dr D P Murphy, of Elmira, New York. Three weeks later a recurrence took place which grew rapidly and involved the glands of the groin. A second operation was performed by Doctor Murphy about two months after the first one. This, also, was followed by a rapid recurrence of still more rapid growth. The patient was referred to Doctor Coley October 19, 1917. Physical examination at that time revealed a tumor the size of two fists, extending down the thigh for a distance of six inches, the lower third of which was a fungating mass with a foul smell and discharge. The tumor, which did not extend upward beyond the external ring, was removed, and the wound was closed with skin from the other side of the scrotum. The patient was immediately put upon the mixed toxins of erysipelas and bacillus prodigiosus. (No other treatment.)

Pathological report by Dr James Ewing (December, 1917) "The specimen is a round, solid, soft, elastic tumor mass, 7 x 8 cm, it fungates through the skin over an area of 4 cm wide, a portion of skin accompanying the specimen. On section the tumor is smooth, translucent, hemorrhagic along the fungating edge. It is circumscribed by an indistinct capsule. No portions of the testicle are visible in the single gross section. On microscopic examination the structure is composed of large and small groups of large polyhedral and spindle cells of indifferent embryonal type, consisting chiefly of hyperchromatic nuclei. These cell groups grade off into an abundant mucinous tissue of myomatous type and every gradation from polyhedral to star-shaped cells may be followed. Some cell clusters surround blood-vessels, which are not numerous. There are scanty small points of necrosis. The diagnosis is embryonal carcinoma of testis, with transition to pseudosarcomatous structure." Doctor Ewing, later reviewing this case stated, that the diagnosis "embryonal carcinoma," as given in his report, was an error, and that he regarded this as one of the very few cases in which he would make a definite diagnosis of "sarcoma of the spindle- and round-cell type."

The toxin treatment was continued at home by the family physician. In view of the marked improvement in the patient's condition, it was thought safe to discontinue the treatment at the end of a few months. About a year and a half later, another nodule the size of a pea, appeared in the neighborhood of the scar. This was removed and pronounced by Doctor Ewing to be of the same structure as the original tumor. The toxins were then resumed and

## SUBFASCIAL LIPOMA OF THIGH

kept up for an even longer period than before. At the present time, seven years and eight months after the last operation, the patient is in excellent condition with no trace of a recurrence.

In view of the fact that frequent operations had failed to control the disease in this case it was only fair to credit the recovery to the prophylactic toxin-treatment. In a previous paper on "End-results in Malignant Disease of the Testis" (ANNALS OF SURGERY, September, 1923), Doctor Coley stated that, in 10 cases in which the toxins were used, alone in 9 cases and combined with radium in 1 case after operation in the hope of preventing a recurrence, 9 were living from 3 to 14 years after operation, and 4 were alive from 10 to 14 years later. Since the publication of this paper, one other case has gone beyond the three-year period of recovery.

## SUBFASCIAL LIPOMA OF THIGH

DR WILLIAM B. COLEY presented a man, sixty-two years of age. General health excellent. On March 5, 1925, he first noticed a swelling of the right thigh occupying chiefly the whole anterior portion. He paid little attention to it as it was not associated with much pain. The swelling continued to increase in size. He consulted a surgeon in Philadelphia, who regarded it as an inoperable fascial sarcoma and referred the patient to Doctor Coley for toxin- and radium-treatment.

Physical examination on April 20, 1925, showed marked enlargement of the whole thigh extending from Poupert's ligament to the upper border of the patella, downwards to the femoral vessels on the inner side, and well over the outer aspect of the thigh. The tumor was soft in consistence and had the typical "feel" of a multilobulated lipoma. The central upper portion of the tumor was of firmer consistence and simulated a sarcoma.

April 25, 1925, operative incision revealed a large tumor lying underneath the quadriceps muscle, extending down to the femur itself and internally in close proximity to the femoral vessels. The great bulk of the tumor had the typical gross appearance of a lipoma. The central and deeper portion was markedly adherent to the muscle, fascia, and periosteum, overlying the femur so that dissection was somewhat difficult. However, the entire tumor was removed *en masse* and the large wound was closed with drainage. The drain was removed at the end of forty-eight hours and the wound healed by primary union. Examination of the tumor after removal showed an apparently typical lipoma, however, in the central portion there was a rounded mass much firmer in consistence than the rest of the tumor, having the macroscopic appearance of a sarcoma.

Pathological report by Dr. F. M. Jeffries (May, 1925): "The growth from leg is a multilobulated lipoma with one hard nodule which, on further study and mature deliberation, I am convinced that we are here dealing with an inflammatory process alone."

Pathological report by Dr. Francis Carter Wood (May 21, 1925): "I have examined the three sections which you sent me. One is fatty tissue with a slight amount of lymphoid infiltration. The other two showed dense connective tissue with very much thickened blood-vessels, and again a heavy lymphocytic infiltration. I see no evidence of tumor. The thickening of the vessels, the peripherally arranged lymphocytes and the general lymphoid infiltration, suggest syphilis—though I presume this has been excluded. In any case I should certainly not feel that the sections sent to me warranted a diagnosis of any tumor except a lipoma."

## NEW YORK SURGICAL SOCIETY

Doctor Coley said that the only other case in his experience that at all resembled the present one was admitted to his service at the Memorial Hospital several years ago. This patient, a middle-aged woman, had a tumor of six to seven years' duration, occupying the whole posterior portion of the thigh. Here also, a diagnosis of fascial sarcoma had been made but the "feel" of the tumor suggested a lipoma. Operation revealed a lipomatous tumor weighing seven pounds. This patient was shown before the New York Surgical Society. The case presented this evening differs from the one just referred to in that the tumor was of shorter duration, but it is fair to assume that the tumor had existed for a much longer period than the patient realized.

Dr. EDWIN BLER said that he had seen a number of arborescent lipomata somewhat similar to Doctor Coley's case, and one patient he had observed over a period of nine years who had a large lipoma of this type running in between the muscles apparently originating in the popliteal space. The patient was operated upon in 1916 for the original lipoma which recurred and was re-operated upon in 1922. At this time she was also operated upon for lipomata under the fascia in the right inguinal region and another one at the root of the neck. All specimens were reported lipomata. In 1924 the patient returned with another large recurrence in the popliteal space, which again proved to be an arborescent tumor running around the vessels and nerves in between the hamstring and flexor muscles as well as closely attached to the calf muscle. The tumor was removed with some of the attached musculature, and this time microscopic examination—though the tumor seemed identical macroscopically with previous tumors removed showed "sarcomatous degeneration."

It would seem from this experience that some of these benign lipomata may undergo sarcomatous changes. Owing to their peculiar growth running in between various structures—muscular, vascular, etc.—a complete eradication may be most difficult especially as during the dissection or enucleation, pieces of the neoplastic tissue are prone to be broken off from the main tumor.

## SARCOMA OF TIBIA AND FIBULA

Dr. GUILFORD S. DUDLEY presented a man fifty-eight years of age, who entered the Second Surgical Division of Bellevue Hospital, April 6, 1925. He had had pain and swelling in the region of his right ankle for the past year. His only history of trauma was of having "turned" this ankle three years previously. Restoration to normal followed three months of supportive strapping.

Examination showed a soft rounded smooth contoured, well-outlined swelling on the lateral aspect of the right ankle measuring about  $6 \times 4 \times 2$  cm. Its posterior border was in contact with the external malleolus. The skin was movable over the tumor, but the tumor was not movable upon the deep structures. There was no "egg-shell"-like crackle or evident enlargement of the superficial veins. There was considerable edema of the entire lower leg, but no enlargement of the inguinal nodes or other evidence of inflammation. The X-ray showed two areas of bone absorption, one in the distal extremity of the tibia and one in the distal extremity of the fibula. There were also visible a few calcific trabeculae in the soft tumor mass. Chest X-ray showed a widening of the aortic arch, but no metastases. X-rays of the

remaining long bones showed no abnormality. The pre-operative diagnosis was "Giant-cell Tumor."

With a tourniquet on the thigh, he was operated upon on April 13, 1925. The palpable tumor consisted of brownish, friable, neoplastic appearing material encapsulated from the soft parts and the ankle-joint, but continuous with tumor tissue within both the tibia and fibula. The barrier between the tumor and the joint, however, was so thin that it was broken through in the attempt at removal, thereby exposing the lateral aspect of the joint. It was impossible to decide from which bone the neoplasm had primarily arisen. The tumor tissue within the bone did not resemble curant jelly, but was of a grayish-white granular appearance. Its removal left an ovoid cavity in the fibula 2 cm. in length and 1 cm. in breadth and a spherical cavity in the tibia 4 to 5 cm. in diameter. A thin shell of articular cartilage effectually excluded the tibial portion of the tumor from the ankle-joint. The cavities in the tibia and fibula left by curettage were treated with pure carbolic acid and alcohol, and the tourniquet removed. A rather profuse ooze of blood was disregarded and the skin wound closed without drainage. A culture taken from the tibia proved to be sterile. The wound healed by primary union.

Doctor Symmer's pathological report was "Specimen consists of a piece of tissue measuring 5.5 x 4 x 2 cm. and about 50 to 60 smaller bits of various sizes. All present the same appearance and are yellowish in color and friable in consistence.

Microscopic. Sections show two types of growth. In one the prevailing cell is a fibroblast which appears to be a rather mature cell. In places this fibroblast appears to be capable of developing strands of more connective tissue. Among the fibroblasts are considerable number of atypical multinucleated giant cells. One can make out here and there, in addition, small numbers of thin-walled apparently newly formed capillary vessels. In other places the ground substance is made up of mature looking fibroblasts scattered among which, in about equal numbers, are large giant cells of the type normally encountered both in the periosteum and endosteum, these cells possessing multiple well-formed, small, moderately chromatic polyhedral nuclei. In some of the sections, muscular and fatty tissues are to be seen and in the interstices are numbers of infiltrating tumor cells. If one depended on the histology alone to indicate the nature of the tumor and the prognosis, one would be inclined to say that the growth is non-malignant and the prognosis good. Histological signs of malignancy are notoriously unreliable. However, in the present case, taking into consideration the man's age, the fact that the tumor was soft, that at operation it was found to extend beyond the bony capsule, and that clinically and histologically there are signs of infiltration of muscular and fatty tissues, it seems to me that the tumor must be regarded as at least locally malignant and that local recurrence is to be expected. Although the question is one which requires exalted surgical judgment, it seems to be that amputation ought to be seriously considered since there is no reason to think that this tumor may not eventually metastasize to distant parts.

Diagnosis "Spindle- and giant-cell sarcoma."

Doctor Ewing, who saw the microscopic slides, stated that, in the absence of repeated surgical insults, metastasis would not occur although the lesion might recur locally. He advised against amputation.

The uncertainty of the outcome and the prolonged convalescence to be anticipated as the result of conservative measures were contrasted to the patient with the comparative certainty and lessened period of invalidism to be expected to follow amputation. He chose to have the leg removed. An

amputation through the middle third of the lower leg was done on April 25, 1925

The case presents three unusual features 1st, the age of the patient, 2nd, the location of the sarcoma, and 3rd, the apparent simultaneous involvement of two bones

DR JOHN A HARIWELL said that this patient illustrates the difficulty of diagnosing these cases and of knowing exactly how to classify them Symmers doubts what terminology to give this disease, but Ewing believes it to be a benign tumor and that it will continue as a localized tumor if not subjected to surgical insult, as he calls it It was to be hoped that this case would bring out a discussion as to whether it should be attacked surgically, or if one should trust to its being benign and only on the action of other curative agents than the operative All surgeons have had good success with taking out such tumors and there has been some success with radiology The diagnosis is almost impossible until the tumor has been cut into If any of the members have had successful experience with other than the operative treatment, it would be interesting to have it repeated

DR WM B COLLY stated that Doctor Dudley had given him an opportunity of examining the X-ray pictures and the slides before the operation, that he had advised conservative treatment with toxins and radium for a brief period before amputation, and that his reason for so doing was based on the fact that in a number of similar cases in which he had strongly urged amputation, but the patient refused to permit it he had succeeded in effecting a cure by conservative treatment Doctor Coley believed that two or three of these cases were of sufficient interest to justify mentioning them in this discussion

CASE I—L G, female, nineteen years old, was admitted to the Hospital for Ruptured and Crippled in October, 1914, with a swelling of the femur of four or five months' duration In this case, not only the lower end of the femur was destroyed, but the whole knee-joint was involved Amputation was strongly advised by Dr V P Gibney and Doctor Coley, but the patient refused to have it done While an exploratory operation was performed, no attempt was made to remove the tumor Microscopic diagnosis by Doctor Ewing Giant- and spindle-cell sarcoma of moderate malignancy While this case is registered in the Bone-sarcoma Registry as a benign giant-cell sarcoma, a diagnosis of malignant tumor was made by Dr Francis Carter Wood, as well as Doctor MacCarty and Doctor Broders of the Mayo Clinic The patient received no other treatment than the mixed toxins of erysipelas and *Bacillus prodigiosus*, which was kept up for nearly a year She made a complete recovery, and has remained well now over ten years She was shown before a clinic at the Memorial Hospital several weeks ago

CASE II—C S, female, twenty-nine years old, was admitted to the Memorial Hospital in November, 1916, with a tumor which had completely destroyed the lower end of the femur, the knee-joint, and had also invaded the upper end of the tibia Amputation had been advised by a surgeon at St Vincent's Hospital, and in view of the extensive involvement of the disease, Doctor Coley believed there was little hope of saving the limb and therefore, also, strongly urged an amputation, this, however, the patient refused Doctor Coley then did an extensive curettage of the entire lower end

of the femur, the knee-joint, and the upper end of the tibia, packing the large cavity, and keeping it clean with Dakin's fluid. The wound healed without any infection. The toxin-treatment was begun on the second or third post-operative day, and kept up for three or four months. Just before she left the hospital, a steel needle of 100 mc of radium was introduced through a small sinus which still remained, and left there for three hours, later on, a pack treatment was given externally. Within four months, the patient was able to get about without crutches, and within a year, the function of the limb was entirely restored and she was able to walk without any noticeable limp. She remained in excellent health until August, 1924, eight years later, when she died from hemorrhages following child-birth. Doctor Ewing's diagnosis in this case was giant- and spindle-cell sarcoma.

CASE III—C. F., female, seventeen years old, was admitted to the Hospital for Ruptured and Crippled on July 22, 1915, with a tumor involving the upper five inches of the tibia, the knee-joint, however, was intact, a thin layer of cartilage still remaining. Amputation was strongly advised by Dr. Royal Whitman. It was decided to try conservative treatment first, so after a thorough curettage, the patient was put upon the mixed toxins. In January, 1916, the treatment was discontinued for a number of weeks, during which time the disease recurred and grew rapidly. A second curettage was done followed by a rapid recurrence. She was then treated with one massive dose of radium, the mixed toxins were kept up for a prolonged period. The patient is well at the present time, ten years later, she has complete restoration of function, and is able to walk without support of any kind. The diagnosis in this case was giant- and spindle-cell sarcoma, benign type by Doctors Ewing, and Bloodgood, malignant by Dr. George Baile.

In view of these results, Doctor Coley believes that in most central tumors of the giant- or giant- and spindle-cell type, conservative treatment should be given a fair trial before resorting to amputation.

Doctor Coley stated that he should like to emphasize the point brought out by Doctor Hartwell that it was extremely difficult for the surgeon to determine the malignancy of a central giant- and spindle-cell sarcoma from the histological structure, as often experienced pathologists were unable to differentiate the malignant from the benign type.

Although Doctor Bloodgood in a paper entitled, "The Giant-cell Tumor of Bone and the Spectic of the Metastasizing Giant-cell" (*Surg., Gynec. and Obst.*, 1924, vol. xxxvii, p. 784), covering 70 cases personally observed and 100 cases collected from the Bone Sarcoma Registry, stated that he had never seen a metastasizing giant-cell sarcoma, Doctor Coley in his paper on, "Prognosis in Giant-cell Sarcoma of the Long Bones" (*ANNALS OF SURGERY*, March and April, 1924), covering 50 consecutive cases personally observed, reported 10 cases in which death had occurred from metastases. Doctor Coley added that since the publication of his paper he had observed three other similar cases in which death had occurred from metastases or extension of the disease. The results in these 13 cases had led Doctor Coley to regard the metastasizing giant-cell tumor as a real "spectic."

Doctor Coley stated it was only fair to mention that some of his early cases occurred many years ago when our knowledge of giant-cell sarcoma was considerably less than it is at present, on the other hand, a number of the

## NEW YORK SURGICAL SOCIETY

cases reported were of comparatively recent observation and had been examined both by Doctor Ewing and Doctor Bloodgood and had been pronounced by them benign giant-cell tumor

In answering the question raised by Doctor Hartwell as to the best method of treating these cases whether by radium or X-rays alone or by surgery combined with toxins, or X-rays or radium, Doctor Coley cited the results obtained at the Memorial Hospital. At this institution, up to January, 1925, there have been treated 26 cases of giant-cell tumor with X-rays or radium, this includes 13 cases in which no previous biopsy or surgical intervention was employed, of these 13 cases only 1 patient has remained alive and well over three years. Of the remaining 13 cases in which X-rays or radium were used after curettage or exploratory operation, 4 are alive and well from three to five years (the limb was saved in three of these cases) 7 went on to amputation, and 4 are dead. In another group of 21 cases treated personally by surgery alone or surgery combined with toxins and radium, the following results were observed: 16 patients are alive and well from three to eighteen years (the limb was saved in 12 cases), in 9 cases amputation was performed (as a primary measure in 4 cases) and 3 are dead.

Doctor Coley stated that while future evidence may possibly show X-rays or radium to be the method of choice, the results thus far obtained have led him to the following conclusion: that, surgical treatment (curettage) followed by the use of carbolic acid or zinc sulphate and then by the use of the mixed toxins, either alone or combined with radium, yields the best results. Certainly, the period of disability is very much shortened by the surgical treatment. Furthermore the latter procedure permits a careful histological study of the structure of the tumor, which is a great advantage, and which is not possible in cases treated by X-rays or radium alone where the diagnosis is based upon clinical and X-ray findings. A study of the Memorial Hospital series shows that there had been an error in diagnosis in about twenty-five per cent of the cases in which the diagnosis was based upon clinical and X-ray evidence.

## CARCINOMA OF THE RECTUM

DR JOHN A. HARTWELL presented a man who had come under his care with the history of having been operated upon for cancer of the rectum by Dr. Arpad Gerster, at Mount Sinai Hospital, in 1884. The operation had been performed by the perineal route and a perineal anus formed. Doctor Hartwell stated that he had been unable to find a record of this case or to identify it in any of Doctor Gerster's writings. Dr. John Gerster has kindly looked through his father's records without success, so that the only knowledge of the pathological condition comes from the patient's statement that Doctor Gerster had exhibited him as a case of carcinoma of the rectum. The patient remained satisfactorily well, without undue trouble from the perineal anus, until about five years ago, when a prolapse began to develop. This gradually increased and he came to the hospital to get relief because of the incontinence which became worse, and the consequent mucus discharge which was present. He was operated upon on March 6, 1925, for this condition. Through a supra-pubic incision the prolapse was reduced by

## CARCINOMA OF THE RECTUM

traction on the recto-sigmoid. Four circular peritoneal layers of sutures were then taken around the pelvic peritoneum and the lateral walls in such a way as to fix the rectum within the pelvis. There were no evidences of any carcinoma either in the liver, the peritoneal glands, or about the rectum. It was difficult to determine how much of the rectum had been removed, but it was estimated that the recto-sigmoid had been drawn down some five or six inches. Except for a slight laxity of the mucosa, the operative procedure had cured the prolapse.

DOCTOR HARTWELL presented three other cases of carcinoma of the rectum operated upon by himself, by the radical combined abdominal and perineal method. The first patient was operated in January, 1921, at the age of seventy-two. He had been entirely well until six months before that time. Then there developed a diarrhoea with blood in his stools and tenesmus at defecation. He had lost twenty pounds in weight, but in spite of this he was in reasonably good condition. Rectal examination revealed a crater-like ulcerating mass about four inches above the anus. At operation there was no apparent extension of the growth beyond the rectum itself, though at one point it had penetrated to the peritoneal coat. The operation was done in one stage by the well-established technic of mobilizing the lower sigmoid, ligation of the inferior mesenteric artery and clearing out all the tissue surrounding the bowel as far down as the prostate. A peritoneal purse-string suture was then placed around the pelvic peritoneum, the bowel sectioned between two clamps and two ends inverted. The distal end was forced into the pelvis and the purse-string suture tied. The proximal end was brought out through a lateral McBurney incision from an artificial anus. The patient was then placed in the exaggerated lithotomy position, anus closed with a heavy purse-string suture and incision made backward from the perineum encircling the anus and ending over the coccyx. The ischiorectal fossae were opened on either side, the levator ani muscles cut, and the dissection carried upward until the segment of bowel was entirely freed to the point where the abdominal dissection had ended. The remaining cavity was left wide open and packed with vaseline gauze. The histological growth was a malignant adenoma with definite gland alveoli infiltrating the submucous and muscular coats. Post-operative course was uneventful. Patient made a good recovery in every way and the large posterior wound healed rapidly. To date the patient is in excellent health, is working regularly, and has very little inconvenience from the colostomy.

Second patient, sixty-four years old, operated on March 7, 1924. His history had been similar to that of the first patient, but had only been of four months' duration. The cancer was seen by the proctoscope about 6 to 8 inches from the anus. Patient was in good general condition, his red blood-cells 5,300,000 and his Hb 95 per cent. He had lost only ten pounds in weight. The operation was performed exactly similar to the one just described. There was, however, a great deal of difficulty in severing the sigmoid and rectum because of adhesions and the fact that the sigmoid was held well over to the right side, making a complex arrangement which was difficult to interpret. Patient, however, stood the operation well, but as a precaution was given 450 cc of blood at the end of the operation. His recovery was complicated by a severe infection in the abdominal wound, and an apparent connection between the peritoneal and pelvic cavities. He, however, recovered without undue delay, and at the present time is in excellent health, and the colostomy is functioning satisfactorily. The pathologist's report is adenoma destruens.



The third patient, age fifty-seven, was operated upon January 16, 1925. His history had extended over a period of ten months, with bleeding from the rectum. He was not in very good physical condition and showed marked constitutional evidence of the disease. Rectal examination showed the cancer to be about four inches from the anus and seemed to be of an encircling ulcerative nature. The operation was done by the same technic as the two previous ones, except that the colostomy was done in the midline. The comparison of these three patients does not seem to show that the midline colostomy has any advantage over the lateral position. It was found that the growth was rather closely adherent to the prostate, and in separating it a small rent was made in the urethra. This could easily have been closed but it was decided that the introduction of a perineal catheter would not complicate the condition and would prevent overdilatation of the bladder, which had occurred in a previous case. In that case the overdilatation was not recognized until it had produced a pressure necrosis in the bladder wall, which in turn was followed by a gangrenous cystitis and caused the death of the patient. The presence of the perineal catheter in no way interfered with the healing of the wound, though there still remains a small perineal urinary fistula, which is continually growing smaller. Unfortunately the specimen in this case was lost between the operating room and the laboratory, so that no microscopical report is available. Examination at the time of the operation revealed a hard scirrhous carcinoma of an annular type about four inches above the anus, and extending upward from this for a distance of at least six inches was a hard pencil-like growth, which on section gave the gross appearance of carcinoma. Doctor Hartwell reported that he had seen one similar case in which the carcinoma as determined by the microscope had extended up the posterior wall of the bowel in this way for a distance of twelve inches. The possibility of such an extension is an important consideration in recommending the combined operation rather than the posterior alone. He was fully convinced that the combined operation with an abdominal colostomy was the operation of choice. In his experience he had been able to perform this operation always in one stage, the patient had stood the operation well and with proper pre-operative preparation and a possible transfusion, he believed there were few cases in which the two-stage procedure of the operation was advisable. While there had been fatalities in his series, there was none in which the two stages would have lessened the danger. One fatality had resulted from anuria, one from gangrenous inflammation of the urinary bladder, and one in which the operation should not have been attempted as the cancer had involved the uterus and pelvis to an extent that made its removal impossible.

DR EDWIN BEER said that in connection with the operation for carcinoma of the rectum—known as the Quenu operation, there were two important details which made for rapid healing and might be considered as an aseptic removal of the bowel. During the last few months he had availed himself of these and had been able to obtain an aseptic nearly primary wound closure and discharged the patients three to four weeks after the operation.

The technic referred to consists in cutting across the sigmoid through the working incision between two Payr clamps with a cautery, then the ends are inverted as the clamps are removed and the stumps ioditized. The proximal stump is brought through a gridiron incision in the left iliac fossa and left closed until distention compels the introduction of a tube, by which time

## CARCINOMA OF THE RECTUM

adequate union and protection of the wound in the iliac musculature has been effected. The lower stump inverted and iodized in the same way is buried in the hollow of the sacrum and subsequently removed by a posterior incision after the anus has been circumcized and closed over with a flap of the adjacent cutaneous tissue. In this way the posterior incision is kept clean and the unopened gut with its contained new growth is removed in one piece with glands attached. This posterior incision in turn can be sewed up almost completely, leaving in only a soft rubber tube-drain in the hollow of the sacrum.

The second point that is referred to above, is the closure of the peritoneum in the floor of the pelvis. To avoid any peritoneal contamination from the posterior incision, a double layer of peritoneal sutures should be made, the deepest layer being continuous, and the more superficial of interrupted sutures which gives a broad approximation of the peritoneum across the floor of the pelvis and closes all the avenues of infection. For these two layers chromic gut is used. The working incision in the median line or through the left rectus muscle is closed in layers and protected with collodion dressing.

Attention to these details has diminished greatly to the period of time that these patients spend in the hospital.

DR GEORGE WOOLSEY said he believed some of these cases were quite suitable for a Mayo modification of the Kraske operation, if one can reach with the finger the upper border of the tumor and it is a recent case. He has had several that have done well with this procedure except in one particular and that is that there is likely to be some sloughing of the lower end of the rectum, especially posteriorly. That leads to a moderate degree of stricture which can be readily treated. He usually does a preliminary colostomy and explores the abdomen through the incision. He agreed with Doctor Stewart that one should never operate without the consent of the patient to do a complete operation with colostomy if the conditions found make it necessary. In a recent case the sigmoid mesentery was so short that he could not have brought the sigmoid down, but because the tumor extended up so far the complete abdomino-perineal operation was done as the operation of choice.

DR WILLY MEYER said that the combined operation is the operation of choice. The fact that such an ascending, pencil-like infiltration is sometimes found, makes it clear that a large portion of the gut should be removed and that cannot be done from below alone. The possibility of being able to palpate the liver, ligate primarily the inferior mesenteric artery and allow of pulling the sigmoid down as far as required, are the great advantages of the combined operation. To his mind it should be done in one stage if possible.

With reference to preparation of the patient. Many years ago it was recommended, if the tumor was not entirely obstructive, to avoid the establishment of an artificial anus by means of rather prolonged preparation. The speaker had followed this experiment in a number of cases and in many had succeeded in getting along without an artificial anus. The patients are daily

## NEW YORK SURGICAL SOCIETY

given larger amounts of castor oil followed by high colonic irrigations. This is carried out for four to five days previous to operation. During this time they are kept on a liquid diet and then laudanum is given the last 36 to 48 hours before operation. However, the majority of surgeons to-day prefer colostomy.

DOCTOR MEYER referred to two patients whom he had presented before this Society not long ago, one was operated on four years ago, the other three years ago. The former was in the early 30's, the other in the 50's. In both cases the tumor was well up in the pelvic colon and found to be attached to the posterior side of the uterus. The combined operation was done in both in one sitting, it being necessary to peel the tumor off the womb. The younger patient is entirely well to-day, the other one in whom it might have been best to do a hysterectomy, had her condition been more promising, was treated with prolonged radiation and is also alive and in a satisfactory condition to-day. The combined method is highly to be recommended and certainly represents the standard operation.

DOCTOR HARTWELL, in closing the discussion, said that he wished only to add that these cases with three others, making six in all, were the only cases that had come on his Division at Bellevue since 1914, that were in any sense operable out of a total number of 34. Two of these six were really not operable. In one an attempt was made to remove the tumor and the patient died the next day. The second was treated by one of the other members of the staff and died shortly after operation. Only 4 in the series of 34 were advisedly operable when admitted to the hospital. Two of the 34 were most favorably localized but were inoperable because of infiltration of the liver, which had developed within approximately a month from the time the patients had had the first symptoms. If the patient is properly prepared, including a transfusion before operation, he will stand the operation in one stage without too much shock. The one-stage operation is preferable because of the difficulty of leaving the segment of bowel without leakage and danger of sepsis before the second operation can be done.

## BOOK REVIEWS

THE SURGERY OF PULMONARY TUBERCULOSIS By JOHN ALEXANDER, B S, M A, M D, Assistant Professor of Surgery in the Medical School of the University of Michigan With introductions by Hugh Cabot, M D, Professor of Surgery and Dean of the Medical School, University of Michigan, and Edward R. Baldwin, M A, M D, Director of the Trudeau Foundation and Trudeau School of Tuberculosis and of the Saranac Laboratory for the Study of Tuberculosis (Samuel D. Gross Prize, awarded 1925) 8 vo Lea and Febiger, Philadelphia and New York, 1925.

All who are interested in the treatment of pulmonary phthisis will find in this excellent work a wealth of accurate information, of logical conclusion and of reliable advice.

With the exception of the subject of therapeutic pneumothorax every known surgical method of dealing with the lungs has been presented. The manner is most scientific and thorough. Nothing has been overlooked and no detail or sidelight has been omitted. Induced pneumothorax is discussed in a well-drawn comparison with thoracoplasty and other purely surgical procedures. In reaching a conclusion which favors thoracoplasty, Alexander wisely warns us that in determining these relative values, statistics are of little service, since the type of the disease and its severity varies greatly in the cases selected for each procedure.

To list all the purely surgical subjects which the author has covered would not be possible in a review, it is sufficient to repeat that nothing is missing and that each operative procedure has been viewed from all sides. Definition, introduction and development, indications and selection of cases, advantages and disadvantages, methods of technic, pre-operative and post-operative care and results, the latter often compared with those of other measures, all are treated in masterly style. There is a profusion of example and precept from the writings and statements of others each reference being accurately placed in an excellent bibliography. And always there is the conclusion of the writer, modest, yet with the stamp of authority.

To illustrate the scope of this big little book, phrenicotomy occupies 26 pages, extrapleural pneumolysis, 22 pages, tuberculous effusion and empyema, 15 pages.

As a human and personal touch there are portraits of a number of the pioneer workers in pulmonary surgery.

Alexander believes that in the United States, major operations for pulmonary tuberculosis should be performed in general hospitals rather than in sanatoria, and he deplores the restrictions commonly imposed on the admission of these patients to the public wards. The University of Michigan Hospital has established a fifty-bed division for the medical and surgical care of

phthisis pulmonalis and it is to be devoutly hoped that other institutions may follow this worthy example

Speaking of treatment preparatory to operation, the employment of digitalis to strengthen the heart is approved in spite of the dictum of the physiologists. But, after all, accurate clinical observations in disease are worth considering as well as the results of pure experimentation

In the selection of operative measures the author gives preference in the majority of cases to the Wilms-Sauerbruch paravertebral thoracoplasty, although in selected instances different forms of surgical therapy may be indicated, such as other modes of thoracoplasty, pneumolysis and filling, and even the drainage of cavities. Pulmonary resection is particularly perilous and is only exceptionally to be recommended

The thoracoscopy of Jacobaeus is regarded as of special value only when there are few and attenuated adhesions and satisfactory pneumothorax can be completed. As a rule, thoracoplasty is preferable

The pictures well illustrate the various points of pathology and technic, the diagrammatic drawings being especially clear and explanatory. There is described and illustrated a composite raspatory devised by the author for simplifying the resection of ribs. The writer of this review can testify to the usefulness and convenience of this instrument

Several tables and graphs showing results and accompanying conditions are useful for reference. Perhaps the most important one is that dealing with 1159 paravertebral thoracoplasties reported 1918-1925

In an introduction by Doctor Baldwin, there is reference to extraordinary difficulties under which this book was written—of these its pages give no hint and Doctor Alexander is to be congratulated upon the spirit which has achieved one of the highest literary honors of his profession

HOWARD LIEBENTHAL

SOME FUNDAMENTAL CONSIDERATIONS IN THE TREATMENT OF EMPYEMA THORACIS. By EVARTS A. GRAHAM, A.B., M.D., Member of Empyema Commission, United States Army, Professor of Surgery, Washington University School of Medicine. Octavo, 110 pages. St. Louis, The C. V. Mosby Company, 1925

This book records the most important advance in the treatment of acute empyema since the disease was recognized as a surgical condition. It is clearly and convincingly written and will be a lasting monument to the originality and resourcefulness of its author. Through the work of Graham and Bell which revolutionized the operative care of empyema during the influenza epidemic, thoracic surgeons accepted the new operative standardization in acute empyema. The present volume condenses all information so that within its few pages we have references beyond which it is hardly necessary to go

There are four sections, the first, entitled "Pathology," deals mainly with the problem of open pneumothorax, its mechanics and the conclusions

drawn from carefully conceived experiment. The important lesson is taught that in the acute stage of empyema there must be no permanent open pneumothorax, however small. Finally, observation made during the epidemic of 1918 appears to have fully justified the author's logic. For example, the drop in mortality at Camp Lee from 48 per cent to 43 per cent. Perhaps the most striking fact brought out is that both normal thoraces may be simultaneously opened with as little danger as one, provided the total area of the openings is not too great to prevent respiration—and the power to breathe under these changed conditions depends upon the vital capacity of the individual. Thus a vigorous subject with a high vital capacity can withstand a larger wound or wounds in his chest wall than one who is weak either by reason of congenital causes or because of disease, such as the pneumonia which usually precedes the empyema.

The importance of fixation of the mediastinum in operations upon the comparatively healthy pleura is stressed and the reasons for the safety of late thoracotomy for empyema is ascribed to the fixation of the mediastinal pleura by exudate. This is supposed to occur in two or three weeks after the beginning of the pneumonia, and may be assumed to exist when aspiration withdraws frank pus instead of opalescent fluid.

Graham does not agree with Elsberg's contention, that an animal with a thoracic wound will breathe more easily in the prone posture than in the erect or supine position. It must be remembered, however, that when a patient is prone, and supported by a pillow so that his lower ribs are elevated well above the horizontal plane, the pleura may be incised in its anatomically lowest part with little or no respiratory embarrassment. This appears to be due to the easy escape of the air through an opening which is now geometrically at the highest point and, perhaps also, because the phrenic movements with their powerful suction and expulsion are greatly limited in amplitude.

The other dangers of open pneumothorax—infection, circulatory disturbance and loss of bodily heat—are discussed. The importance of Dakin's fluid as a disinfectant is brought out.

In Section II Graham deals with the Prevention of Chronic Empyema, a condition produced by fibrosis of the lung and by solid exudate, both interfering with pulmonary expansion. He rightly maintains that the best treatment is by the shortest method which will accomplish sterilization and obliteration of the diseased pleural cavity. He prefers a solution of the exudate by Dakin's fluid to mechanical decortication. Others, however, have found surgical mobilization of the lung necessary when the hypochlorite has failed. Graham seems to disapprove of permitting the chest wound to heal in the presence of an apparently sterile pneumothorax. Here many surgeons will differ, since in a large proportion of these cases, permanent cure with full obliteration of the cavity has been observed.

Section III is devoted to the importance of a high calory diet (3500) so as to improve nutrition. This and the advantages of the free ingestion of water are too little appreciated by the general mass of the profession,

and Graham has done well to emphasize the necessity of these adjuncts to convalescence

Section IV is occupied by a discussion of a few matters not previously taken up. The treatment of pulmonary fistulas and the necessity for regarding them as possible outlets for suppurations within the lung are mentioned.

"When is an empyema healed?" is partly answered by the statement that numerous cultures should have demonstrated probable sterility before the opening may be permitted to close, and that healing may not be considered as secure for at least six months.

In an addendum, the author admits that owing to the thin and fragile canine mediastinum dogs may not in all respects be suitable for experiments which bear upon human conditions. This may be true of surgery upon the healthy chest but it certainly does not invalidate the conclusions drawn from a study of empyema.

The greater part of Graham's work was done before 1920 the date when the S. D. Gross prize was awarded to the essay which forms the bulk of the book, and therefore many of its facts are familiar to thoracic surgeons. This does not, however, alter the value of the present volume but places it rather among those which should be found on one's library shelves.

HOWARD LILIENTHAL

#### To Contributors and Subscribers

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

**ANNALS of SURGERY**

227-231 So. 6th Street

Philadelphia, Penna.

# INDEX TO VOLUME LXXXII

## A

- Abdominal Incisions, Broken-down, 452  
 Abdominal Sepsis, Note on Treatment of, 314  
 Abscess of Liver from Pylephlebitis, Following Appendectomy, 308, of Lung, Splenic Anæmia Complicated by, 819  
 Abscesses and Intracranial Tumors Causing Communicating Hydrocephalus, 199  
 Acidity, Gastric, Failure of Gastro-enterostomy to Effect a Decisive Reduction in, 925  
 Actinomycosis Treated by Potassium Iodide Ionization, 647  
 ADIE, GEORGE C Etiology of Cancer of the Stomach, 86  
 ALEXANDER, JOHN Surgery of Pulmonary Tuberculosis, Edited by, Review of, 989  
 American Surgical Association, Presidential Address by A J Ochsner, 1925, 321  
 Anatomy, Applied, Edited by Gwilym Davis, Review of, 318  
 Aneurism, Aortic, Late Result of Needling an, 512, Arteriovenous, 815  
 Angina Pectoris, Operative Treatment of, 354  
 Antiseptics, Skin, The Efficiency and inefficiency of Certain, 640  
 Aortic Aneurism, Late Result of Needling an, 512  
 Appendectomy, Intestinal Obstruction After, 805  
 Appendectomy Stump, "Ligation and Drop," Treatment of the, 260  
 Appendicitis, Chronic, The Relation of Total and Polymorphonuclear Leucocyte Counts in, 960, and Transposition of the Viscera, 256  
 Arm and Forearm, Hæmolytic Streptococcus Gangrene of, 813  
 Arteriovenous Aneurism, 815, Fistula, 293  
 Arthritis Deformans of the Hip, Operative Treatment for, 808, Septic of the Knee, 818

## B

- BALFOUR, DONALD C The Sequelæ of Gastro-enterostomy, 421  
 BECK, CARL On the Crippled Hand and Arm, Review of, 317  
 Benign Tumors of the Duodenum, 952

- BERESNEGOVSKI, N J Surgical Treatment of Epilepsia Partialis, 698  
 BERKMAN, DAVID M Primary Carcinoma of the Duodenum, 153  
 BEST, R RUSSELL Granuloma Inguinale, 273  
 Bilateral Duplication of Renal Pelves and Ureters, 968, Mammary Cancer Operations, 63  
 Bile Duct, Common, Hepatic and Cystic Ducts, Observations on the Histologic and Pathologic Anatomy of the, 584  
 Bladder, Gall, Disease in Early Life, 646, Urinary, Hernia of the, 264, Sliding Hernia of the, in a Child and Strangulated Femoral Hernia, 818  
 BLAKE, JOSEPH A Carcinoma of Rectum, 177  
 Blood-lymph-vascular System, Neoplasms of the, with Special Reference to endotheliomas, 710  
 Blood Stream, The Conception of Septicæmia and the Fate of Microbes in the, 326, Supply of Whole-thickness Skin Grafts, Origin and Development of, 871, Transfusion, the Value of, in Surgery of the Prostate, 974  
 Bowel, Large, Papillomata of the, 109  
 Brain Surgery, Contributions to, 513, Tumors, Removal of Certain Deep-seated, 513  
 Breast Cancer, Value of X-ray Radiation in the Treatment of, 404  
 Breast Carcinoma, Pseudo Recurrences After Radial Amputation, 81, Result of Deep X-ray Treatment of Inoperable Recurrent, 807  
 Breast, Epithelial Hyperplasia of the, 673, Male Tumors of the, 45  
 Breasts, Carcinoma, Simultaneous, of Both, 661  
 BRUNKOW, CLARENCE W Hernia of the Bladder, 264  
 BUCHANAN, J J Extraction Through the Thorax of Projectiles Long Resident in the Lung, 390  
 BUIE, LOUIS A Technic for the Removal of Hemorrhoids, 964  
 BUNTS, FRANK E Some Considerations Pertaining to the Diagnosis and Surgical



- Treatment of Diseases of the Gall-bladder, 232
- BURDEN, VERNAL G Observations on the Histologic and Pathologic Anatomy of the Hepatic, Cystic and Common Bile-Ducts, 584
- C**
- CABOT, HUGH Etiology of Cancer of the Stomach, 86
- Cancer Operations, Bilateral Mammary, 63
- Cancer of the Stomach, Etiology of, 86, of the Thyroid and its Present-day Treatment, 833
- Carcinoma, Basal-cell, the Transplantation of Distant Skin Flaps for the Cure of Intractable, 14, of the Body of the Uterus, 131, of Breast, Result of Deep X-ray Treatment of Inoperable Recurrent, 807, of the Clitoris, 825, Late Results of Resection of the Oesophagus for, 190, Mammary, an Evaluation of Pre-operative and Post-operative Radiation in the Treatment of, 404, Metastatic, in the Ureter, 142, Primary, of the Duodenum, 153, Primary, of the Small Intestine in an Octogenarian, 429, of the Breast, Pseudo Recurrences After Radical Amputation for, 81, of Rectum, 177, 984, of the Rectum and Recto-sigmoid, 656, Simultaneous, of Both Breasts, 652, 661, of the Stomach, Partial Gastrectomy for, 803
- CARREL, ALEXIS Mechanism of the Formation and Growth of Malignant Tumors, 1
- CARSON, H W Modern Operative Surgery, Edited by, Review of, 318
- CARSON, WILLIAM JAMES Metastatic Carcinoma in the Ureter, 142
- CARTER, R FRANKLIN Gastric Resection for Pyloric and Duodenal Ulcer, 920
- CAYLOR, HAROLD D Epitheliomas in Sebaceous Cysts, 164
- Cerebro-spinal Fluid, Acute Hypotension of, Following Cranial Traumatism, 678
- CHEATLE, SIR GEORGE LENTHAL Epithelial Hyperplasia of the Breast, 673
- Chyluria, Non-parasitic, 765
- Clitoris, Carcinoma of the, 825
- CLOPTON, MALVERN B Splenectomy for Purpura Hemorrhagica, 413
- COHLN, IRA Periarterial Sympathectomy, 704
- COLF, WARREN H Compensatory Lengthening of the Femur in Children After Fracture, 609
- COLEY, WILLIAM B Effect of Mixed Toxins on Recurrent Sarcoma of the Testicle, 978, Anatomy and Treatment of Reducible Inguinal Hernia, 668, Sub-fascial Lipoma of Thigh, 979
- Collapse, Acute Massive, of the Lungs, 364
- CORP, RALPH Congenital Cysts and Fistule of the Neck, 854
- Compression of the Spinal Cord by Tumor, 865
- Congenital Cysts and Fistule of the Neck, 854
- CONWELL, H EARLE Closed Reduction of Acute Dislocations of the Semilunar Carpal Bone, 289
- Cranial Traumatism, Acute Hypotension of Cerebro-spinal Fluid Following, 678
- CRAVER, LLOYD F Cancer of the Thyroid and its Present-day Treatment, 833
- CRUIK, GEORGE W A Hanger Method for the Repair of Prolapsed Uteri, 509
- Criminals, Habitual, Imbeciles, Perverts, Paupers, Morons, Epileptics and Degenerates, the Surgical Treatment of 321
- Crippled Hand and Arm, Treatise on, by Carl Beck, Review of, 319
- CUIVIER, HARRY B Horseshoe Kidney, 735
- Cystic, Hepatic and Common Bile-ducts Observations on the Histologic and Pathologic Anatomy of the, 584
- Cysts and Fistule, Congenital, of the Neck, 854, of the Ilio-psoas Bursa, 277, Sebaceous, Epitheliomas in, 164
- D**
- DANDY, WAITER E Intracranial Tumors and Abscesses Causing Communicating Hydrocephalus, 199, Removal of Certain Deep-seated Brain Tumors, 513, Intracranial Approach with Concealed Incisions, 513, Contributions to Brain Surgery, 513
- DAVIS, JOHN STAIGE Origin and Development of the Blood Supply of Whole-thickness Skin Grafts, 871
- DAVIS, GWILYM Applied Anatomy, Revised by Geo P Muller, Review of, 318
- DAVIS, LINCOLN Carcinoma of the Body of the Uterus, 131
- DAVID, VERNON C Papillomata of the Large Bowel, 109

## INDEX

- DECOURCY, JOSEPH L Improved Goitre Technic, 215
- DEAVER, JOHN B Treatment of Uterine Fibroids, 486
- Degenerates, Habitual Criminals, Imbeciles, Perverts, Paupers, Morons, Epileptics, the Surgical Treatment of, 321
- Dermatitis, X-ray, of Palms, Abdominal Flaps for, 655
- Dermoids, Ovarian, Bilateral, Management of, 483
- Dilatation, Acute, of the Stomach and Tetanoid Convulsions, Following Operation for Hernia, 303
- Dislocations, Acute, of the Semilunar Carpal Bone, Closed Reduction of, 289
- Diverticula of the Jejunum, 250
- DODSON, AUSTIN I The Value of Blood Transfusion in Surgery of the Prostate, 974
- DORRANCE, GEORGE M Lengthening the Soft Palate in Cleft Palate Operations, 208, Rhinoplasty, 308
- DUDLEY, GUILFORD S Sarcoma of Tibia and Fibula, 980
- DUNN, LOUIS X-ray as a Diagnostic Aid in Cases of Hæmangioma, 880
- Duodenal and Pyloric Ulcer, Gastric Resection for, 920
- Duodenal Ulcer, Bleeding, Partial Gastrectomy, 809
- Duodenum, Benign Tumors of the, 952, Primary Carcinoma of the, 153
- DWIGHT, KIRBY Reconstruction Work After Extensive Laceration of Forearm and Hand, 659
- E**
- EISENDRATH, DANIEL N Horseshoe Kidney, 735
- ELIASON, E L Post-appendectomy Pylephlebitis with Liver Abscess, 308
- ELIOT, ELLSWORTH, JR Acute Perforated Pyloric Ulcer, 663, Anatomy and Treatment of Reducible Oblique Inguinal Hernia, 441, Gastro-enterostomy for Pyloric Ulcer, 664, Sarcoma of Trachea, 667
- ELSBERG, CHARLES A Symptoms and Late Results in Neoplasms of the Spinal Cord, 180
- ELTING, ARTHUR W Fat Embolism, 336 Embolism, Fat, 336
- Embolism and Thrombosis, Clinical Considerations of, 193
- Enterostomy, Gastro, the Sequelæ of, 421
- Epigastric Pain a Symptom of Œsophageal Obstruction, 212
- Epilepsia Partialis, Surgical Treatment of, 698
- Epileptics, Degenerates, Habitual Criminals, Imbeciles, Perverts, Paupers, Morons, the Surgical Treatment of, 321
- Epiphysitis, Vertebral, 286
- Epithelial Hyperplasia of the Breast, 673
- Epitheliomas in Sebaceous Cysts, 164
- ESTES, WILLIAM L Implantation of an Ovary, 475
- Etiology of Cancer of the Stomach, 86
- EUSTERMAN, GEORGE B Primary Carcinoma of the Duodenum, 153
- Exophthalmos, Pulsating, 662
- F**
- Facial Tissue, Relaxed, Fascial Bands as Supports to, 603
- Failure of Gastro-enterostomy to Effect a Decisive Reduction in Gastric Acidity, 925
- Fallopian Tube, Acute Torsion of the, 646
- FARR, CHARLES E Benign Tumor of the Stomach, 823, Fracture of the Hard Palate, 821, Septic Arthritis of the Knee, 818, Splenic Anæmia Complicated by Lung Abscess, 819, Strangulated Femoral Hernia and Sliding Hernia of the Bladder in a Child, 818, Unilateral Fused Kidney, 822
- FARR, ROBERT EMMETT Hernia of the Bladder, 264
- Fascial Bands as Supports to Relaxed Facial Tissue, 603
- Fat Embolism, 336
- FLIDMAN, ROBERT H Failure of Gastro-enterostomy to Effect a Decisive Reduction in Gastric Acidity, 925
- Femoral Hernia, Strangulated, and Sliding Hernia of the Bladder in a Child, 818
- Femur, Compensatory Lengthening of the, in Children after Fracture, 609
- Fibroids, Uterine, Treatment of, 486
- Fibula, Traumatic Luxation of the Head of the, 635
- Fibula and Tibia, Sarcoma of, 980
- Fistula, Arteriovenous, 293, Fecal, Persistent, Treated by Ileo-cæcal Resection and

## INDEX

Ileo-colostomy, 306, Intestinal, Cure of, Near the Duodeno-jejunal Junction, 310  
 Fistulæ and Cysts, Congenital, of the Neck, 854  
 Forearm and Arm, Hemolytic Streptococcus Gangrene of, 813  
 Forearm and Hand, Reconstruction Work after Extensive Laceration of, 659  
 FOWLER, W. FRANK Infantile Pyloric Stenosis, 940  
 Fracture, Depressed of Skull Involving Speech Centre, 832, of the Neck of the Humerus 813 of the Hard Palate, 821  
 Fracture-dislocation, Irreducible, of the Hip Open Operation in an Adult for, 301  
 Fractures, Active Motion in the Treatment of, 617  
 Fractures and Dislocations Treatise on, by Philip D. Wilson, Review of 316  
 FRAWLEY, JOHN M. Klippel-Feil Syndrome, 728  
 FRAZER, CHARLES H. Spinal Cord Tumors 182  
 Fundamental Considerations in the Treatment of Empyema Thoracis, Edited by EVARTS A. GRAHAM, Review of, 997  
 Fused Unilateral, Kidney, 822

### G

Gall-bladder Disease in Early Life, 646, Diseases of the, Some Considerations Pertaining to the Diagnosis and Surgical Treatment of, 232  
 Gangrene, Hemolytic Streptococcus, of Arm and Forearm, 813  
 Gastrectomy, Partial, for Carcinoma of the Stomach, 803, Partial, Penetrating Gastric Ulcer, 809  
 Gastric Acidity, Failure of Gastro-enterostomy to Effect a Decisive Reduction in, 925  
 Gastric Resection for Pyloric and Duodenal Ulcer, 920  
 Gastric Ulcer, Penetrating, Partial Gastrectomy, 809  
 Gastro-enterostomy, Failure of, to Effect a Decisive Reduction in Gastric Acidity, 925, for Pyloric Ulcer, 664, the Sequelæ of, 421  
 GATCH, WILLIS D. Cysts of the Ilio-psoas Bursa, 277

GIRSTER, JOHN A. C. Carcinoma of the Clitoris, 825, Intestinal Obstruction after Appendectomy, 805  
 GIBSON, THOMAS E. Malignant Tumors of the Testicle, 552  
 Goutre Technic, Improved, 215  
 Grafts, Skin, Free, Full-thickness, 654  
 GRAHAM, ALLEN Malignant Tumors of the Thyroid, 30  
 GRAHAM, EVARTS A. Some Fundamental Considerations in the Treatment of Empyema Thoracis Edited by Review of 990  
 Granuloma Inguinale, 273  
 GRIFFIN, NATHAN W. Chronic Suppurative Pyelonephritis, 651, Cicatricial Stricture of the Oesophagus, 648, Lung Suppuration, 649  
 GRIFFIN, W. F. Cysts of the Ilio-psoas Bursa, 277  
 GRUCA, ADAM. Myositis Ossificans Circumscripta, 883

### H

Hæmangioma X-ray as a Diagnostic Aid in Cysts of, 880  
 Hemolytic Streptococcus Gangrene of Arm and Forearm, 813  
 Hand and Forearm, Reconstruction Work after Extensive Laceration, 659  
 HANSHU, H. S. Spontaneous Rupture of the Spleen, 598  
 Hard Palate, Fracture of the, 821  
 HARTMAN, HOWARD R. Pancreatic Lithiasis, 956  
 HARTWILL, JOHN A. Carcinoma of the Rectum, 984  
 Heart, Ventricle of, Bullet Perforating, and Migrating to Femoral Artery, 301  
 Hemorrhagicæ, Purpura, Splenectomy for, 413  
 Hemorrhoids, Technic for the Removal of, 964  
 Hepatic, Cystic and Common Bile-ducts, Observations on the Histologic and Pathologic Anatomy of the, 584  
 HERENDEIN, RALPH E. An Evaluation of Pre-operative and Post-operative Radiation in the Treatment of Mammary Carcinoma, 404  
 Hernia, Anatomy and Treatment of Reduc-

# INDEX

ble Inguinal, 668, of the Bladder, 264, of the Lung, 220, Oblique Inguinal, Anatomy and Treatment of Reducible, 441, Retroperitoneal, 576, Strangulated Femoral, and Sliding Hernia of the Bladder in a Child, 818

HIGGINS, C C Retroperitoneal Hernia, 576

HINMAN, FRANK Malignant Tumors of the Testicle, 552

Hip, Open Operation in an Adult for Irreducible Fracture-dislocation of the, 304, Operative Treatment for Arthritis Deformans of the, 808

HITZROT, JAMES M Late Results of Splenectomy for Idiopathic Purpura, 663, Pulsating Exophthalmos, 662, Simultaneous Carcinoma of Both Breasts, 661

HOLDER, HALL G The Relation of Total and Polymorphonuclear Leucocyte Counts in Chronic Appendicitis, 960

HOMANS, JOHN Treatment of Uterine Prolapse and Rectocele by Closure of the Pouch of Douglas, 501

Horseshoe Kidney, 735

HORSLEY, J SHELTON The Transplantation of Distant Skin Flaps for the Cure of Intractable Basal-cell Carcinoma, 14

Humerus, Fracture of the Neck of the, 813

Hyperplasia, Epithelial, of the Breast, 673

Hypotension, Acute, of Cerebro-spinal fluid Following Cranial Traumatism, 678

## I

Incisions, Abdominal, Broken-down, 452, Concealed, Intracranial Approach with, 513

Ilio-psoas Bursa, Cysts of the, 277

Imbeciles, Perverts, Paupers, Morons, Epileptics, Degenerates, Habitual Criminals, the Surgical Treatment of, 321

Implantation of an Ovary, 475

Infantile Pyloric Stenosis, 940

Inguinal Granuloma, 273

Inguinal Hernia, Anatomy and Treatment of Reducible, 441, 668

Intestinal Fistula, Cure of, Near the Duodeno-jejunal Junction, 310

Intestinal Obstruction After Appendectomy, 805

Intestine, Small, Primary Carcinoma of the, in an Octogenarian, 429

Intracranial Approach with Concealed Incisions, 513

Intracranial Tumors and Abscesses Causing Communicating Hydrocephalus, 199

Intraperitoneal Transfusion for Melena, 830

Intussusception in Adults Due to the Invagination of a Meckel's Diverticulum, 436

Iodide Potassium Ionization, Actinomycosis Treated by, 647

IVY, ROBERT H Rhinoplasty for Syphilitic Defect of Nose, 830

## J

JACKSON, CHEVALIER Acute Massive Collapse of the Lungs, 364

Jejunum, Diverticula of the, 250

JOPSON, JOHN H Acute Dilatation of the Stomach and Tetanoid Convulsions Following Operation for Hernia, 303, Bullet Perforating Ventricle of Heart, Migrating to Femoral Artery, 301, Open Operation in an Adult for Irreducible Fracture-dislocation of the Hip, 304, Persistent Fecal Fistula Treated by Ileo-cæcal Resection and Ileo-colostomy, 306

JUDD, EDWARD STARR Partial Resection of the Kidney, 458

## K

KERR, HARRY HYLAND Operative Treatment of Angina Pectoris, 354

Kidney, Horseshoe, 735, Partial Resection of the, 458, Unilateral Fused, 822

KLINGENSTEIN, PERCY Congenital Cysts and Fistulæ of the Neck, 854

Klippel-Feil Syndrome, 728

Knee, Septic Arthritis of the, 818

KOSTER, HARRY Cure of Intestinal Fistula Near the Duodeno-jejunal Junction, 310

KUTZMANN, ADOLPH A Malignant Tumors of the Testicle, 552, Non-parasitic Chyluria, 765

## L

Laceration, Extensive, of Forearm and Hand, Reconstruction Work After, 659

LASERSOHN, MARTIN Note on Benign Tumors of the Duodenum, 952

# INDEX

- BURTON, J. An Evaluation of Pre-operative and Post-operative Radiation in the Treatment of Mammary Carcinoma, 404
- LEE, WALTER ESTHER Acute Massive Collapse of the Lungs, 364
- Lengthening, Compensatory, of the Femur, in Children after Fracture, 609
- Leucocyte Counts in Chronic Appendicitis, the Relation of Total and Polymorphonuclear 960
- LEWIS, PHILIP Vertebral Epiphysitis 286
- LEWISOHN, RICHARD Bleeding Duodenal Ulcer, Partial Gastrectomy 809, Penetrating Gastric Ulcer Partial Gastrectomy, 809, Failure of Gastro-enterostomy to Effect a Decisive Reduction in Gastric Acidity 925
- "Ligation and Drop," Treatment of the Appendectomy Stump, 260
- LIHNTSHAI, HOWARD Actinomycosis Treated by Potassium Iodide Ionization, 647, Review of Alexander on the Surgery of Pulmonary Tuberculosis, 989, of Graham on the Treatment of Empyema Thoracis 990
- Lipoma Prehincial 971, Subfascial, of Thigh, 979
- Lithiasis Pancreatic 956
- LOWIE, WILLIAM E. Intussusception in Adults Due to the Invagination of a Meckel's Diverticulum, 436, Retroperitoneal Hernia, 576
- Lung Abscess, Splenic Anemia Complicated by, 819
- Lung, Extraction Through the Thorax of Projectiles, Long Resident in the, 390, Hernia of the, 220
- Lung Suppuration, 649
- Lungs, Acute Massive Collapse of the, 364
- LUTZ, HARRY Hernia of the Lung, 220
- LYLE, HENRY H. M. Traumatic Luxation of the Head of the Fibula, 635, Arterio-venous Aneurism, 815, Hemolytic Streptococcus Gangrene of Arm and Forearm, 813
- Lymph, Blood, Vascular System, Neoplasms of the, with Special Reference to Endotheliomas, 710
- M
- MACEWEN, JOHN A. C. Late Result of Needling an Aortic Aneurism, 512
- Male Breast, Tumors of the, 45
- Malignant Tumors of the Thyroid, 30, Mechanism of the Formation and Growth of, 1
- MALONEY, JOHN J. The "Ligation and Drop," Treatment of the Appendectomy Stump, 260
- Mammary Cancer Operations Bilateral, 63
- Mammary Cancers Bilateral, 652, 661
- Mammary Carcinoma an Evaluation of Pre-operative and Post-operative Radiation in the Treatment of, 404
- MARTIN, CHARLES E. Fat Embolism, 336
- MARTIN, WILTON The Conception of Septicemia and the Fate of Microbes in the Blood Stream 326
- MATHIAS, FRANK S. Management of Bilateral Ovarian Dermoids, 483, Pelvoperitoneal Tumor Dissipated by X-ray Therapy, 658
- MAYO, CHARLES H. Methods of Ureteral Repair and Transplantation 472
- McWHIRTERS, CLARENCE A. Bilateral Mammary Cancer Operations, 63, 652, X-ray Dermatitis of Palms, Abdominal Flaps for, 655, Free Full-thickness Skin Grafts, 654
- Meckel's Diverticulum Intussusception in Adults Due to the Invagination of a, 436
- Melenia Intraperitoneal Transfusion for, 830
- MINNICK, WILLIAM C. The Relation of Total and Polymorphonuclear Leucocyte Counts in Chronic Appendicitis, 960
- Metastatic Carcinoma in the Ureter, 142
- MIXER, WILLY Result of X-ray Treatment of Inoperable Recurrent Breast Carcinoma, 807
- MILLER, CHARLES CONRAD Fascial Bands as Supports to Relaxed Facial Tissue, 603
- MILLIKIN, SEYMOUR M. Fracture of the Neck of the Humerus, 813
- Mixed Tumors, Effect of, on Recurrent Sarcoma of the Testicle, 978
- MINTIR, WILLIAM JASON Compression of the Spinal Cord by Tumor, 865
- MONTGOMERY, JAMES G. Hernia of the Lung, 220

## INDEX

- Morons, Epileptics, Degenerates, Habitual Criminals, Imbeciles, Perverts, Paupers, The Surgical Treatment of, 321
- MOSCHCOWITZ, ALEXIS V Pseudo Recurrences after Radical Amputation of the Breast for Carcinoma, 81
- Motion, Active, in the Treatment of Fractures, 617
- Myositis Ossificans Circumscripta, 883
- ### N
- Neck, Congenital Cysts and Fistulæ of the, 854
- Neoplasms of the Blood-lymph-vascular System with Special Reference to Endotheliomas, 710, of the Spinal Cord, Symptoms and Late Results in, 180
- New York Surgical Society, Transactions of the, 180, 646, 803, 978
- NOBLE, THOMAS P Klippel-Feil Syndrome, 728
- Nose, Rhinoplasty for Syphilitic Defect of, 830
- ### O
- O'CONOR, JOHN Note on the Treatment of Abdominal Sepsis, 314
- OCHSNER, ALBERT J Surgical Treatment of Habitual Criminals, Imbeciles, Perverts, Paupers, Morons, Epileptics and Degenerates, 321
- Oesophageal Obstruction, Epigastric Pain a Symptom of, 212
- Oesophagus, Cicatricial Stricture of the, 648, Resection of the, for Carcinoma, Late Results of, 190
- Omentum, Great, Torsion of the, 312
- Operative Surgery, Modern, Edited by H W Carson, Review of, 318
- Ossificans Circumscripta, Myositis, 883
- Osteomyelitis, Acute, The Mechanism of, 781
- Ovarian Dermoids, Bilateral, Management of, 483
- Ovary, Implantation of an, 475
- ### P
- Palate, Hard, Fracture of the, 821, Soft, Lengthening the, in Cleft Palate Operations, 208
- Palms, X-ray Dermatitis of, Abdominal Flaps for, 655
- Pancreatic Lithiasis, 956
- Papillomata of the Large Bowel, 109
- Paupers, Morons, Epileptics, Degenerates, Habitual Criminals, Imbeciles, Perverts, the Surgical Treatment of, 321
- PECK, CHARLES H Carcinoma of the Rectum and Recto-sigmoid, 656, Partial Gastrectomy for Carcinoma of the Stomach, 803
- Pectoris, Angina, Operative Treatment of, 354
- Pelvo-abdominal Tumor Dissipated by X-ray Therapy, 658
- Periarterial Sympathectomy, 704
- PERSSON, MAURITZ Renal Tuberculosis 526
- Perverts, Paupers, Morons, Epileptics, Degenerates, Imbeciles, Habitual Criminals, the Surgical Treatment of, 321
- PHIFER, FRANK M Horseshoe Kidney, 735
- Philadelphia Academy of Surgery, Transactions of the, 180, 301, 829
- Prehernal Lipoma, 971
- PRIMROSE, ALEXANDER Primary Carcinoma of the Small Intestine in an Octogenarian, 429
- Procidentia Uteri, a Hanger Method for the Repair of, 509
- Projectiles, Long Resident in the Lung, Extraction Through the Thorax of, 390
- Prostate, The Value of Blood Transfusion in Surgery of the, 974
- PRYOR, JESSIE W Cyst of Thyroglossal Duct, 829
- Pseudo Recurrences after Radical Amputation of the Breast for Carcinoma, 81
- Pyelonephritis, Chronic Suppurative, 651
- Pylephlebitis, Post-appendectomy, with Liver Abscess, 308
- Pyloric, Infantile, Stenosis, 940
- Pyloric Ulcer, Acute Perforated, 663, Gastro-enterostomy for, 664
- Pyloric and Duodenal Ulcer, Gastric Resection for, 920
- Purpura Hemorrhagica, Splenectomy for, 413, Idiopathic, Late Results of Splenectomy for, 663
- PULFORD, D SCHUYLER, JR Neoplasms of the Blood-lymph-vascular System with Special Reference to Endotheliomas, 710

R

- Radiation, X-ray, Value of, in Breast Cancer, 104  
 Rectocele and Uterine Prolapse, Treatment of, by Closure of the Pouch of Douglas, 501  
 Rectum, Carcinoma of, 177, 984, and Recto-sigmoid, Carcinoma of the, 656  
 REIMANN, STANLEY PHILIP Treatment of Uterine Fibroids, 486  
 Renal Pelvis and Ureters, Bilateral Duplication of, 968  
 Renal Tuberculosis, 526  
 Retroperitoneal Hernia, 576  
 Rhinoplasty, 308, for Syphilitic Defect of Nose, 830  
 ROEMAN, JOHN S Depressed Fracture of Skull Involving Speech Centre, 832  
 ROTHSCHILD, NORMAN S Diverticula of the Jejunum, 250  
 Rupture, Spontaneous, of the Spleen 246, 598

S

- Sarcoma of Tibia and Fibula, 980, of Trachea, 667, Recurrent, of the Testicle, Effect of Mixed Toxins on, 978  
 SAROFI, JACOB Torsion of the Great Omentum, 312  
 Sebaceous Cysts, Epitheliomas in, 164  
 Semilunar Carpal Bone, Closed Reduction of Acute Dislocations of the, 289  
 Sepsis, Abdominal, Note on the Treatment of, 314  
 Septicæmia, the Conception of, and the Fate of Microbes in the Blood Stream, 326  
 SHIFFRY, ARTHUR M Broken-down Abdominal Incisions, 452  
 SHARPE, WILLIAM End Results in Neurosurgery, 684  
 Skin Antiseptics, The Efficiency and Inefficiency of Certain, 640  
 Skin Flaps, Distant, the Transplantation of, for the Cure of Intractable Basal-cell Carcinoma, 14  
 Skin Grafts, Free, Full-thickness, 654, Origin and Development of the Blood Supply of Whole-thickness, 871

- Skull, Depressed Fracture of, Involving Speech Centre, 832  
 Sliding Hernia of the Bladder in a Child, and Strangulated Femoral Hernia, 818  
 Soft Palate, Lengthening the, in Cleft Palate Operations, 208  
 Speech Centre, Depressed Fracture of Skull Involving, 832  
 SPENCER KILGORE Tumors of the Male Breast 45  
 Spleen, Spontaneous Rupture of the, 246, 598, Wandering, with Torsion of its Pedicle, 239  
 Splenectomy, Late Results of, for Idiopathic Purpura, 663, for Purpura Hemorrhagica, 413  
 Splenic Anemia Complicated by Lung Abscess, 819  
 Spinal Cord, Compression of the by Tumor, 865, Symptoms and Late Results in Neoplasms of the, 180, Tumors, 182  
 Stenosis, Infantile Pyloric 940  
 STEVENS, G W Active Motion in the Treatment of Fractures, 617  
 Stomach, Acute Dilatation of the, and Tetanoid Convulsions Following Operation for Hernia, 303 Benign Tumor of the, 823, Etiology of Cancer of the, 86, Partial Gastrectomy for Carcinoma of the, 803  
 Strangulated Femoral Hernia and Sliding Hernia of the Bladder in a Child, 818  
 Streptococcus, Hæmolytic, Gangrene of Arm and Forearm, 813  
 STRICKER, P Acute Hypotension of Cerebro-spinal Fluid Following Cranial Traumatism, 678  
 Stricture, Cicatricial of the Oesophagus, 648  
 STUIZ, E Acute Hypotension of Cerebro-Spinal Fluid Following Cranial Traumatism, 678  
 Subfascial Lipoma of Thigh, 979  
 Surgery of Pulmonary Tuberculosis, Edited By John Alexander, Review of, 989  
 SUTTON, H B The Efficiency and Inefficiency of Certain Skin Antiseptics, 640  
 SUTTON, JOHN E, JR Wandering Spleen with Torsion of its Pedicle, 239

## INDEX

SWAN, THEODORE S Primary Carcinoma of the Duodenum, 153  
 Sympathectomy, Periarterial, 704  
 Syphilitic Defect of Nose, Rhinoplasty for, 830

### T

Testicle, Effect of Mixed Toxins on Recurrent Sarcoma of the, 978, Malignant Tumors of the, 552  
 Tetanoid Convulsions and Acute Dilatation of the Stomach Following Operation for Hernia, 303  
 Thigh, Subfascial Lipoma of, 979  
 THOMASON, THOMAS HERBERT Arterio-venous Fistula, 293  
 Thorax, Extraction Through the, of Projectiles Long Resident in the Lung, 390  
 Thrombosis and Embolism, Clinical Considerations of, 193  
 Thyroglossal Duct, Cyst of, 829  
 Thyroid, Cancer of the, and its Present-day Treatment, 833, Malignant Tumors of the, 30  
 Tibia and Fibula, Sarcoma of, 980  
 TINKER, MARTIN B The Efficiency and Inefficiency of Certain Skin Antiseptics, 640  
 TOREK, FRANZ Late Results of Resection of the Œsophagus for Carcinoma, 190  
 Torsion, Acute of the Fallopian Tube, 646, of the Great Omentum, 312  
 Trachea, Sarcoma of, 667  
 Transfusion, Intraperitoneal, for Melena, 830  
 Transplantation of Distant Skin Flaps for the Cure of Intractable Basal-cell Carcinoma, 14  
 Transposition of Viscera and Appendicitis, 256  
 TRAUT, HERBERT F Origin and Development of the Blood Supply of Whole-thickness Skin Grafts, 871  
 TRUESDELL, EDWARD D Acute Torsion of the Fallopian Tube, 646, Gall-bladder Disease in Early Life, 646  
 Tuberculosis, Renal, 526  
 Tumor, Pelvo-abdominal, Dissipated by X-ray Therapy, 658

Tumors, Benign, of the Duodenum, 952, Brain, Removal of Certain Deep-seated, 513, Intracranial, and Abscesses Causing Communicating Hydrocephalus, 199, of the Male Breast, 45, Malignant, Mechanism of the Formation and Growth of, 1, Malignant, of the Testicle, 552, of Spinal Cord, 182

### U

Ulcer, Acute Perforated Pyloric, 663, Bleeding Duodenal, Partial Gastrectomy for, 809, Gastric, Penetrating, Partial Gastrectomy, 809, Gastric Resection for Pyloric and Duodenal, 920, Pyloric, Gastro-enterostomy for, 664  
 Ureter, Metastatic Carcinoma in the, 142  
 Ureteral Repair and Transplantation, Methods of, 472  
 Ureters and Renal Pelves, Bilateral Duplication of, 968  
 Uteri, Procidentia, a Hanger Method for the Repair of, 509  
 Uterine Fibroids, Treatment of, 486  
 Uterine Prolapse, Treatment of, and Rectocele by Closure, of the Pouch of Douglas, 501, Hanger Method for the Repair of, 509  
 Uterus, Carcinoma of the Body of the, 131

### V

Vertebral Epiphysitis, 286  
 VIETOR, JOHN A Clinical Considerations of Thrombosis and Embolism, 193  
 VINSON, PORTER P Epigastric Pain a Symptom of Œsophageal Obstruction, 212  
 Viscera, Transposition of the, and Appendicitis, 256

### W

WALTHER, HENRY W E Bilateral Duplication of Renal Pelves and Ureters, 968  
 Wandering Spleen with Torsion of its Pedicle, 239  
 WATSON, LEIGH F Prehernal Lipoma, 971  
 WELLS, J RALSTON Intraperitoneal Transfusion for Melena, 830



# INDEX

WHITMAN, ROYAL Operative Treatment  
for Arthritis Deformans of the Hip, 808  
WIERNSKY, ABRAHAM O The Mechanism  
of Acute Osteomyelitis, 781  
WHITIS A MURAT Note on Benign  
Tumors of the Duodenum, 952  
WHITIS, BYRD CHARLES Appendicitis and  
Transposition of the Viscera, 256  
WILSON, PHILIP D On Fractures and  
Dislocations, Review of, 316  
WOHL, MICHAEL G Spontaneous Rupture  
of the Spleen, 216

## X

X-ray Dermatitis of Palm, Abdominal  
Haps for, 655, as a Diagnostic Aid in  
Cases of Hamangioma, 880, Radiation,  
Value of, in Breast Cancer, 404, Treat-  
ment, Deep, of Inoperable Recurrent  
Breast Carcinoma, Result of, 807

## Y

YATES, JOHN LAWRENCE Active Motion in  
the Treatment of Fractures, 617

